

The background of the entire page is a 3D rendering of a complex molecular or crystal lattice structure. It consists of numerous interconnected nodes (spheres) and bonds (tubes), creating a porous, interconnected network. The structure is rendered in a dark, metallic blue color with a glossy, reflective surface that catches the light, giving it a three-dimensional appearance. The nodes and bonds are arranged in a way that suggests a crystalline or molecular framework, typical of materials science or metallurgy. The overall effect is one of scientific precision and technological advancement.

METALLURGICAL
AND
MATERIALS
ENGINEERING



ORTA DOĞU TEKNİK ÜNİVERSİTESİ
MIDDLE EAST TECHNICAL UNIVERSITY

The mission of Department of Metallurgical and Materials Engineering at METU is to educate engineers and researchers with universal qualifications that can meet the needs and expectations of the industry and lead them in their development and to contribute to the transformation of the produced knowledge and technologies into social welfare by carrying out research that can respond to the changing needs of the country in matters of interest.

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Message from the Chair



METU Department of Metallurgical Engineering was found in 1966; and parallel to the changes in the world, in 1995, it was renamed as METU Department of Metallurgical and Materials Engineering. The department has celebrated its 50th anniversary in 2016. Since the day the department was established, we have been contributing to our national interests and the world's scientific community with its well-educated graduates and cutting edge research. In the Department, all faculty members have internationally proven academic skills.

Our department has an ABET-accredited undergraduate program since 1995.

METU Department of Metallurgical and Materials Engineering is accepting undergraduate applications with the highest percentile in the nationwide university entrance examination in its academic field. Each year, 82 students have the privilege to start their bachelor's degree in this department. In 2018, the mathematics and science scores of students joining our program ranged from 7,623rd to 22,329th.

Metallurgical and materials engineering is the basis for all engineering. Many of today's engineering problems stem from the limitations of currently available materials. Benefits of this fact is immense. First, Metallurgical and Materials Engineering is an interdisciplinary program. Our department not only has faculties with education from different disciplines and the faculties who participates in interdisciplinary programs; but also, currently offers more than 20 elective courses at undergraduate and graduate levels. The second main advantage is that every industry, one way or another, need to deal with materials on a daily basis. Therefore, our alumni has a wide and expanding spectrum of job oppor-

tunities and have been securing positions in major national and international companies, research institutes, universities, research and development departments, as well as launching their own start-up ventures. Furthermore, the need to develop brand-new products with innovative features allows our graduates to obtain positions in high technology fields, i.e. concept development and design, computer aided modeling and simulations, research and development. Our graduates are accepted into the top graduate schools across the globe.

The research conducted in our department includes, but not limited to, biomaterials and nanomedicine, coatings and thin films, electromagnetic materials, energy storage devices and batteries, foundry, metal processing, automotive materials, hydrometallurgy, pyrometallurgy, materials chemistry, nanomaterials, novel alloys design and development, photocatalytic materials, polymers, nanocomposites, shape memory alloys, solid mechanics, surface science, thermochemical and electromechanical materials, functional and smart materials and colloid science.

Our department has a strong infrastructure, including state-of-the-art equipments available for both undergraduate and graduate education. Currently there are 7 general service and 19 research laboratories. Each faculty member holds these research laboratories specialized to their area of research.

With all, METU Metallurgical and Materials Engineering Department is an internationally recognized department and is a pioneer and a leader department in its field in Turkey.

Prof. C. Hakan Gür

About Us

The department was found in 1966 as METU Department of Metallurgical Engineering; and parallel to the changes in the world, in 1995 it was renamed as METU Department of Metallurgical and Materials Engineering. In 1963, with the request of Prof Dr Mustafa Parlar, the Dean of Engineering, Dr. Mustafa Doruk from mechanical engineering department and Prof. Ariel Taub (Technion-Israel) began putting efforts to start the Metallurgical Engineering Department. In 1964, core faculty of the department was recruited. In the same year, 11 volunteers from the sophomore year of Mechanical Engineering established the first class of Metallurgical Engineering.

On June 30th 1966, METU Board of Trustees decided to establish the Department of Metallurgical Engineering. Until 1972, when the department began using government funds for buildings and equipment, UNESCO, AID and CENTO funded the laboratories and majority of the research projects.

From 1965 to 1963, academicians from Sweden (Dr. Hermann Unckel), Norway (Dr. Terkel Rosenqvist), UK (Dr. John Critchley, Dr. Jeffrey Taylor) and USA (Dr. Mario Gomez, Dr. John Shyne) sent by UNESCO, AID and CENTO helped founding and developing the department. With the support of METU president Kemal Kurdaş, faculty requirements were determined and research assistants were channeled to obtain their doctorates. In addition, graduate students earning their Ph.D.'s abroad were accepted to the department.

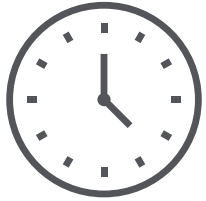




Our graduates are preferred in new and traditional material technologies, material products and process development fields; working efficiently and effectively in priority areas such as defense, energy, transportation and biotechnology; preferred as an engineer and researcher in leading and important private and state institutions; following graduation, continuing their education in the relevant engineering and science departments of respected universities and has successful academic careers both in national and international level; distinguished as a leader and expert in their careers and professional engineers who contribute to professional organizations in the professional field and participate in continuous training events.

Graduates of our department in government and private sectors primarily work in the defense industry (TAI, TEI, Aselsan, Roketsan etc.), in iron and steel (Erdemir, İsdemir, Kardemir etc.) and casting industries, in polymer industry (Lassa, Petlas, Goodyear etc.), in whiteware and electronics sector (Arçelik, Vestel, Başarı, Bosch etc.), in manufacturing sector (Noksel, Sarkuysan, Borusan, Çimtaş etc.), in ceramics and glass industry (Şişecam, Çanakkale Seramik, Kütahya Porselen etc.), in automotive industry (Türk Traktör, Ford, MAN, Otokar etc.) and in energy sector (Yiğit Akü, Mutlu Akü, Botaş, Tüpraş etc.).

Facts and Figures



Founded in 1966

Duration of Study

Bachelor 4 years
Master 2 years
Doctorate 4 years

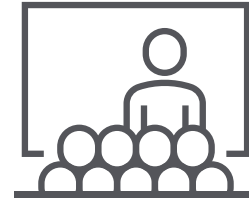


FULL-TIME FACULTY

14 Professors
1 Associate Professors
4 Assistant Professors

STUDENTS

440 Undergraduate
160 Graduate
16 International
12 Minor
3 Double Major



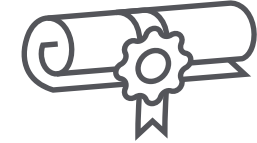
COURSE CREDITS

147 Undergraduate
21 Master
21 Doctorate



PROJECTS & PUBLICATIONS

1 National Projects
7 TUBITAK Projects
Total budget of 12.000.000 TL
260 Articles (last 5 years)
250 of in international journals
10 of in national journals



DEGREES

3063 B.Sc.
696 M.Sc.
86 Ph.D.



Undergraduate Curriculum

The Department of Metallurgical and Materials Engineering is concerned with the generation and application of knowledge on engineering materials. It comprises such aspects as the extraction and refining processes, synthesis and processing of materials, factors affecting the internal structure of solids, methods of altering the structure and properties of materials and factors affecting the materials behavior in service. Materials are crucial in all other fields of engineering, since innovations in materials often lead to improvements in design or sometimes to the emergence of brand new products. In short, most fields of work or study have a bit of metallurgy and materials in them.

Materials of concern are metals and alloys, ceramics, glasses, polymers and their composites. The undergraduate curriculum comprises a core program that emphasizes principles basic to all these classes of materials. It builds upon courses on physics, chemistry and certain aspects of solid mechanics with a series of courses on internal structure of solids covering both chemical and physical aspects and structure-property relations.

From the fifth semester on, the core curriculum addresses to career opportunities in metallurgical and materials engineering. These include the metal industries, ceramic industries and other small scale industries that normally deal with a variety of materials. Iron and steel plants, non-ferrous industries, rolling mills, foundries, heat treatment shops, glass industry, structural ceramics and electronic-magnetic ceramic industries, aerospace and their related small scale industries are only a few examples for the employment opportunities.

First Semester

PHYS105	General Physics I	(3-2)4
CHEM111	General Chemistry I	(3-2)4
MATH119	Calculus with Analytical Geometry	(4-2)5
ME105	Computer Aided Engineering Graphics	(3-0)3
ENG101	English for Academic Purposes I	(4-0)4
IS100	Introduction to Information Technologies and Applications	NC

Course Descriptions

METE102 Introduction to Metallurgical and Materials Engineering (2-0)2

Historical perspective of materials in the service of mankind and civilization. Development of metals, alloys, ceramics, polymers, and composites. Production, processing, properties and performance of conventional and modern materials. Domestic and international activities in metallurgical and material industries.

METE201 Materials Science I (3-0)3

Classification of materials and properties. Atomic theory and atomic bonding in solids, the structure of crystalline and non-crystalline materials; atomic coordination and packing, structure types in crystalline solids, amorphous materials. Imperfections in solids, point, line and surface defects. Phase equilibria, one and two-component systems. Atom movements and diffusion. Phase transformations: concepts of driving force, nucleation, growth and TTT curves.

METE202 Materials Science II (3-0)3

Introduction to properties of materials. Mechanical behavior of solids: Elasticity, theoretical strength, plastic deformation, fracture, creep, fatigue, viscosity, viscoelasticity. Thermal properties of materials: Thermal conductivity, thermal expansion, thermoelectricity. Electronic properties, optical properties, magnetic properties and chemical properties.

METE203 Thermodynamics of Materials I (3-0)3

Concepts and definitions. First law of thermodynamics; internal energy, heat and work, heat capacities, enthalpy and applications to material processing. The second law of thermodynamics; heat engines Carnot cycle, entropy concept. The third law of thermodynamics. Auxiliary thermodynamic functions, Gibbs and Helmholtz energies, Maxwell relations. Equilibrium. Reaction equilibria in gas mixtures.

METE204 Thermodynamics of Materials II (3-0)3

Reaction equilibria between condensed materials and a gaseous phase, Oxidation of metals and Ellingham diagram, Solution thermodynamics, partial and integral molar quantities, Gibbs-Duhem equation, relative partial and relative integral molar quantities. Microscopic examination of solutions, ideal non-ideal solutions, excess properties. Gibbs-Duhem integration. Applications to materials systems. Reaction equilibria in solutions.

METE206 Materials Laboratory (1-2)2

Mechanical testing; tensile testing, impact testing and hardness. Heat treatment and microstructures; annealing, quenching and tempering of steel. Crystallography and X-ray diffraction; phase identification. Temperature measurement. Calorimetry. Physical property measurement.

Undergraduate Curriculum

Second Semester

PHYS106	General Physics II	(3-2)4
CHEM112	General Chemistry II	(3-2)4
MATH120	Calculus for Functions of Several Variables	(4-2)5
METE102	Introduction to Metallurgical and Materials Engineering	(2-0)2
ENG102	English for Academic Purposes II	(4-0)4

Third Semester

MATH219	Introduction to Differential Equations	(4-0)4
METE201	Materials Science I	(3-0)3
METE203	Thermodynamics of Materials I	(3-0)3
METE215	Materials Processing Laboratory	(1-2)2
CENG230	Introduction to C Programming	(2-2)3
ENG211	Academic Oral Presentation Skills	(3-0)3

Fourth Semester

ES223	Statics and Strength of Materials	(4-0)4
METE202	Materials Science II	(3-0)3
METE204	Thermodynamics of Materials II	(3-0)3
METE206	Materials Laboratory	(1-2)2
ES361	Computing Methods in Engineering	(3-0)3
	Restricted Elective (PHYS207, CHEM282, BIO255)	(3 -0)3

Fifth Semester

METE300	Summer Practice I	NC
METE301	Phase Equilibria	(3-0)3
METE303	Mechanical Behavior of Materials	(4-0)4
METE305	Transport Phenomena	(4-0)4
METE307	Metallic Materials & Metallography	(3-2)4
METE349	Electrical, Magnetic & Optical Properties of Materials	(3-0)3

Course Descriptions

METE215 Materials Processing Laboratory (1-2)2

Fundamentals of materials processing. Laboratory experiments and data analysis in materials processing. Particle size reduction and analysis, fabrication of ceramics by pressing and firing, sol-gel processing of ceramics, polymer compounding and shaping, roasting of a copper sulfide concentrate, leaching and electrowinning, solidification of materials and mechanical shaping of materials.

METE300 Summer Practice I (Non-Credit)

Summer practice of at least 21 working days preferably carried out in a plant that will involve processing of materials in an integrated manner. Report prepared at the end of summer practice should reflect both the practical experience and the knowledge gained in the second year courses.

METE301 Phase Equilibria (3-0)3

Phase diagrams of materials systems. Geometric relationship and thermodynamic fundamentals. Phase relations in unary systems, binary isomorphous systems, and binary systems containing invariant reactions. Ternary systems; projections of liquidus and solidus surfaces, Alkemade lines, compatibility relations, ternary invariant reactions, paths of equilibrium crystallization, isothermal and vertical sections.

METE302 Principles of Solidification (3-0)3

Liquids and Solids. Solidification of pure metals. Homogeneous and heterogeneous nucleation. Solidification of alloys, undercooling, solidification of eutectics. Constitutional undercooling. Growth in pure metal and alloys. Distribution coefficient. Macrostructure development. Classification of alloys according to their freezing range. Centerline feeding resistance. The rate of solidification, heat transfer in solidification. Segregation, single crystal growth, zone refining, rapid solidification.

METE303 Mechanical Behavior of Materials (4-0)4

Continuum mechanics; concepts of elasticity and plasticity. Micromechanics of deformation in metals, ceramics, and polymers. Dislocation slip, twinning and plasticity of polymers. Strengthening mechanisms. Time and temperature dependent deformation; creep, superplasticity, and viscoelasticity. Fracture behavior of materials; ductile and brittle fracture mechanisms, fracture transitions. Principles of fracture mechanics and toughness. Fatigue of materials; fatigue design and life prediction.

METE305 Transport Phenomena (4-0)4

Basic concepts in transport phenomena. Mass, energy and momentum balances. Classification of fluid flows and friction; laminar and turbulent flow. Mass transport; diffusion in the solid state, multicomponent diffusion and diffusion in multiphase alloys. Heat transport; conduction, convection and radiation.

Undergraduate Curriculum

Sixth Semester

METE302	Principles of Solidification	(3-0)3
METE350	Multi-Scale Modeling & Simulation of Materials	(2-2)3
METE306	Chemical Principles of Primary Materials Processing	(4-0)4
METE308	Physical Foundations of Materials	(4-0)4
METE310	Structure and Characterization of Materials	(3-2)4

Seventh Semester

METE400	Summer Practice II	NC
METE401	Materials Engineering Desing I	(3-0)3
METE451	Ceramic Materials	(3-0)3
METE453	Polymer Materials	(3-0)3
	Non-Technical Elective	(0-0)3
	Technical Elective	(0-0)3
	Technical Elective	(0-0)3

Eighth Semester

METE402	Materials Engineering Design II	(1-4)3
	Free Elective	(0-0)3
	Non-Technical Elective	(0-0)3
	Non-Technical Elective	(0-0)3
	Technical Elective	(0-0)3
	Technical Elective	(0-0)3

Course Descriptions

METE306 Chemical Principles of Primary Materials Processing (4-0)4

Unit operations and unit processes in metallurgy. Overview of pyro, hydro, and electrometallurgical principles. Thermodynamics and kinetics of chemical reactions. Effects of concentration and temperature on rates of chemical reactions. Pretreatment, reduction, smelting and matte smelting processes with selected examples on the metallurgy of copper, iron, zinc and lead. Stoichiometric principles, charge calculations, and material balance. Heat balance; choice of reactions, with selected examples on non-ferrous metals and ferrous alloys.

METE307 Metallic Materials and Metallography (3-2)4

Fundamentals of microstructural characterization of metals. Specimen preparation. Optical microscopy examination. The correlation of the microstructure with the processing history and the properties of the metal alloys. Ferrous alloys. Non-ferrous alloys. Lightweight alloys and high-temperature alloys. The microstructure - property relationship in advanced alloys developed for automotive industry, chemical industry, power plants, nuclear plants and medical applications. Scanning electron microscopy examination. Fractography. Failure of alloys. Failure analysis and microstructure.

METE308 Physical Foundation of Materials (4-0)4

Homogeneous and heterogeneous nucleation. Interfaces: classification, geometry and energy of interfaces, grain boundary segregation, mobility of interfaces and normal grain growth. Precipitation: free energy-composition diagrams, precipitation transformations and kinetics, coarsening. Eutectoid transformation and discontinuous precipitation. Recovery and recrystallization.

METE310 Structure and Characterization of Materials (3-2)4

Concepts of short and long-range order; symmetry operations, symmetry elements, group theory, point groups, space groups, reciprocal lattice, tensor representation of crystals and their properties, nature and properties of X-ray and electron beams, X-ray and e-beam spectroscopy, X-ray and electron diffraction, phase identification, structure determination, crystallite and microstrain measurement, precise lattice parameter measurement.

METE349 Electrical, Magnetic and Optical Properties of Materials (3-0)3

Electron energy levels and bands. Free electron theory of metals. Fermi-Dirac statistics. Metals, semiconductors, insulators. Electronic transport, conduction in metals. Electrical resistivity of metals. Intrinsic and extrinsic semiconductors. Superconductors. Electrical properties of junctions. Techniques of making p-n junctions. Magnetic properties of materials: diamagnetic, paramagnetic materials, ferrites. Optical properties of materials.

Undergraduate Curriculum

Course Descriptions

METE350 Multi-Scale Modeling and Simulation of Materials (2-2)3

Basics of computational materials science. Mathematical and physical basis of modeling. Methodology for developing models. Simulation of models as finite systems. Microscale methods: molecular dynamics and Monte Carlo. Mesoscale methods: kinetic Monte Carlo, Monte Carlo at the mesoscale, cellular automata, phase-field, dislocation dynamics and crystal plasticity. Macroscale finite element methods and integrated modeling and simulation at multiple-scales.

METE400 Summer Practice II (Non-Credit)

Summer practice of at least 21 working days carried out in an establishment suitable with option courses followed in the third year. A comprehensive report is required which will combine the knowledge gained in the third year courses with the practical experience gained by the student.

METE401 Materials Engineering Design I (3-0)3

Design process. Steps of design. Design tools. Designing against failure. Materials selection design. Process selection in design. Case studies in materials and process selection. Economic decision making in design. Engineering ethics and discussions.

METE402 Materials Engineering Design II (1-4)3

Capstone design project course. Design of devices, parts, processes or systems related to metallurgical and materials engineering. Ethics in engineering and design, professional safety issues and discussions.

METE451 Ceramic Materials (3-0)3

Classification of ceramic products with respect to their functions. Classical and modern Ceramics. Methods of ceramic production: Natural and synthetic raw materials, shaping methods, drying and firing of ceramic articles. Effect of processing on the development of microstructures and properties. Examples of ceramics selected from the major groups of triaxial whitewares, electrical ceramics, magnetic ceramics, refractories, cements and mortars, abrasives, glasses and glass ceramics.

METE453 Polymer Materials (3-0)3

Relationships between structure, properties and processing of polymer materials. Effects of compounding, reinforcing and processing on the behavior of three basic classes of polymers; thermoplastics, thermosets and elastomers. Polymer blends and composites. Materials selection during design of polymer components for strength, stiffness, toughness, resistance to fatigue, creep, and hostile environments. Comprehensive comparison of the behavior of polymer materials with metals and ceramics.



Minor Programs

Minor Program in Structural Materials

Compulsory courses:

METE201	Materials Science I	(3-0)3
METE202	Materials Science II	(3-0)3
METE303	Mechanical Behavior of Materials	(4-0)4

4 elective course(s) approved by the Department of Metallurgical and Materials Engineering.

Total minimum credit: 22

Minor Program in Ceramic Materials

Compulsory courses:

METE201	Materials Science I	(3-0)3
METE202	Materials Science II	(3-0)3
METE301	Phase Equilibria	(3-0)3
METE451	Ceramic Materials	(3-0)3

3 elective course(s) approved by the Department of Metallurgical and Materials Engineering.

Total minimum credit: 21

Minor Program in Electronic Materials

Compulsory courses:

METE201	Materials Science I	(3-0)3
METE202	Materials Science II	(3-0)3
METE349	Electrical, Magnetic & Optical Properties of Materials	(3-0)3

4 elective course(s) approved by the Department of Metallurgical and Materials Engineering.

Total minimum credit: 21



Graduate Curriculum

M.S. Program through courses and thesis aims to provide advanced level of knowledge in the field as well as tools and techniques of research with their implementation within the context of a comprehensive thesis.

The program through doctoral dissertation aided by courses aims to provide maturity in the knowledge as well as to advance it beyond the level already known. The ability to conduct independent research, the creativity in the tools and techniques of research, ability for formulating steps to reach new synthesis are the main objectives.

M.S. in Metallurgical and Materials Engineering

METE500	M.S. Thesis	NC
METE501	Thermodynamics of Materials	(3-0)3
METE503	Math. Methods in Materials Research	(3-0)3
METE506	Kinetic of Processes in Materials	(3-0)3
METE570	Research Methods and Ethics in Metallurgical and Materials Engineering	NC
METE590	Seminar	(0-2)0

4 elective course(s) approved by the Department of Metallurgical and Materials Engineering.

Total minimum credit: 21

Ph.D. in Metallurgical and Materials Engineering

METE570	Research Methods and Ethics in Metallurgical and Materials Engineering	NC
METE580	Prethesis Seminar	(0-2)0
METE600	Ph.D. Thesis	NC

7 elective course(s) approved by the Department of Metallurgical and Materials Engineering.

Total minimum credit: 21

Course Descriptions

METE500 M.S. Thesis (Non-Credit)

Program of research leading to M.S. degree, arranged between student and a faculty member. Students register to this course in all semesters starting from the beginning of their first semester while the research program or write-up of thesis is in progress.

METE501 Thermodynamics of Materials (3-0)3

Advanced treatment of the thermodynamic properties of inorganic materials. Laws of thermodynamics and their application to the chemical behavior of materials systems. Multicomponent systems, phase and chemical reaction equilibria. Thermodynamics of phase transformations. Introductory surface thermodynamics.

METE503 Math. Methods in Materials Research (3-0)3

Review of ordinary differential equations, partial differential equations, solution techniques, special functions, separation of variables, transform techniques, approximate techniques.

METE506 Kinetic of Processes in Materials (3-0)3

Scope of kinetics; Analysis of kinetic data; Chemical kinetics; Rate theories; Transport in solids, liquids and gases; Kinetics of homogenization, carburizing, decarburizing, gas-metal reactions, oxidation, internal oxidation and nitriding, dissolution processes in liquids and solids, precipitation processes in liquids and solids, deformation.

METE570 Research Methods and Ethics in Metallurgical and Materials Engineering (2-2)3

Introduction to the scientific research and ethical behaviour. Carrying out literature review and acquiring knowledge from scientific articles. Formulating research goals and making a plan to reach these goals. Writing an independent research proposal. Ethical behaviour in research process and in presentation of results. Quality in research and ability to reason in critical manner. Controlling the quality and improving the knowledge in scientific literature in a specific research area.

METE580 Pre-thesis Seminar (Non-Credit)

Students register to this course following advisor assignment, i.e. first or second semester in MS program and the third semester at the latest in Ph.D. program. Students are required to give a seminar on their thesis subject and participate in the discussion of seminars given by others. The seminar should cover such aspects as; aim of the study, a comprehensive literature review and work plan to achieve the aim.

METE590 Seminar (Non-Credit)

A seminar course for M.S. students in their third or fourth semester who are near completing their thesis. Students are required to give a seminar on their thesis subject and participate in the discussion of seminars given by others. The seminar should cover the details of work carried out and main findings as well as plan of remaining work to be carried out.

METE600 Ph.D. Seminar (Non-Credit)

Program of research leading to Ph.D. degree, arranged between student and a faculty member. Students register to this course in all semesters starting from the beginning of their first semester while the research program or write-up of thesis is in progress.

Graduate Curriculum

Integrated Ph.D. in Metallurgical and Materials Engineering

CEIT725	Research Methods and Ethics	NC
METE501	Thermodynamics of Materials	(3-0)3
METE503	Math. Methods in Materials Research	(3-0)3
METE506	Kinetic of Processes in Materials	(3-0)3
METE580	Prethesis Seminar	(0-2)0
METE590	Seminar	(0-2)0
METE600	Ph.D. Thesis	NC

7 elective course(s) approved by the Department of Metallurgical and Materials Engineering.

Total minimum credit: 42



Research Interests

Our department embraces the strong research tradition of METU, where our research interests and thesis studies span from metallurgical investigations including iron-steel, non-ferrous alloys, casting, metal forming, heat treatment, surface modification, welding and non-destructive testing, which are most desired for our nations' industrial needs; to more materials science based research mainly targeted towards future technological improvements including electronic and magnetic materials, ceramics, biomaterials, nanotechnology and energy storage materials.



Research Laboratories of Faculty

Biomaterials and Nanomedicine Laboratory

The group is interested in integrating fundamental materials science concepts with biological principles to improve currently used biomaterials to heal damaged tissues. Particularly, biomaterial surface features are modified to possess nanostructures to promote orthopedic, cardiovascular and skin cell interactions, while enhancing antibacterial properties.

Major devices used in the laboratory:

Inverted microscope, Incubator, Class II biological safety cabinet, freezer, microplate reader, liquid nitrogen tank, precision balance, centrifuge, pH meter, rocker.

Coatings and Thin Films Laboratory

The research carried out in the group is mainly on high temperature and corrosion protection coatings, oxide thin films, and vacuum controlled heat treatment of metals and alloys.

Major devices used in the laboratory:

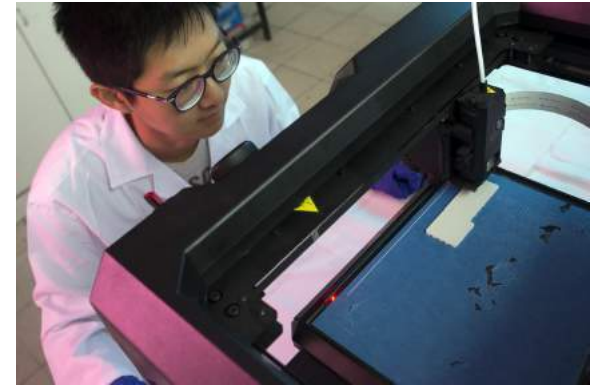
Chemical vapor deposition for aluminizing, chromizing and rare earth/transition metal modification in vertical furnace and a horizontal furnace, Atomic layer deposition system, low vacuum heat treatment furnace, metal coatings thickness measurement equipment, one dimensional profilometer.

Colloid and Smart Materials Laboratory

The research in the group is based on colloid and interfacial phenomena, and materials chemistry. The current research topics include, but not limited to, synthesis of micro and nanoparticles, colloidal processing, rheology, surface modification, functional and smart materials, and suspension batteries. The interdisciplinary research projects include metals, ceramics, polymers and their combinations in multicomponent systems.

Major devices used in the laboratory:

Rheometer, 3D-Printer for robocasting of ceramics and printing of polymer-ceramic composites, high temperature furnace.



Electromagnetic Materials Laboratory

The group is focused on interaction of electromagnetic waves with matter, microwave processing of bulk and surface composites, electromagnetic interference shielding potential of multilayer composites as well as optical and mechanical characterization of ceramic composites, synthesis and characterization of textured barium ferrite ceramics and developing pathways for the processing of “bioinspired” polymer matrix composites.

Major devices used in the laboratory:

High temperature sintering furnace, microwave sintering furnace, cold isostatic press, tape caster, high shear mixer, titration system, vector network analyzer, free space measurement setup



Energy Storage Devices and Battery Laboratory

The group is focused on the design, production and characterization of secondary batteries based on Lead-Acid Ni – MH batteries and Li – Ion batteries.

Major devices used in the laboratory:

Planetary ball mill, glove box, chamber and split and bottom loading furnaces, vacuum drying oven, humidity chamber, freeze dryer, potentiostat/galvanostat systems.

Energy Storage Materials Laboratory

The group deals with energy storage materials and the related areas. The main activity of the group is directed towards metal-hydrides of low stability, i.e. compounds capable of storing and releasing hydrogen near ambient condition, suitable for gas-solid and electrochemical storage of hydrogen. We therefore deal with the synthesis of nanostructured materials using a variety of techniques i.e. mechanical milling, thin film processing and thermal plasma. Activities in the related fields cover hydrogen separation membranes and nanoporous materials.

Major devices used in the laboratory:

Vacuum/pressure induction melting system, glove box, magnetron sputtering system, induction plasma system with nanopowder reactor, spark discharge generator, Sievert's PCT instrument, gas permeability tester, potentiostat/galvanostat system.



Foundry, Metal Processing and Automotive Materials Laboratory

This laboratory is equipped with casting, forging, rolling, thermal analysis system during solidification and semi industrial scale heat treatment furnaces. Equipments are available to study processing of both industrial alloys and metal matrix composites for automotive, defence and machine industry.

Major devices used in the laboratory:

Induction furnaces with different capacities, vacuum induction melting, pressure die caster, thixo-caster, centrifugal casting machine, vertical hydraulic double action press multiple purpose for squeeze casting hot forming and powder pressing, aluminum melting resistance furnace, sand muller, optical emission spectrometer.

Materials Chemistry Laboratory

A processing laboratory specializing in low-temperature materials synthesis by chemical routes, suited for sol-gel processing of ceramics and glasses and coatings; hybrid bio/inorganic and organic/inorganic materials.

Major devices used in the laboratory:

FTIR spectrometer, UV-Vis spectrometer, isothermal titration calorimeter, viscometer, spin and dip coaters.

Nanomaterials and Devices Laboratory

The group is focused on the synthesis and solution processing of semiconducting and metallic nanowires/carbon nanotubes and exploiting their novel properties in flexible devices. Devices of interest include, but not limited to solar cells, light emitting diodes, batteries, supercapacitors, transistors and photodetectors.

Major devices used in the laboratory:

Plasma enhanced chemical vapor deposition system, CVD system, ultrasonic spray pyrolysis system, physical vapor deposition, glove box, spectrometer/photometer/integrated sphere, light sources/UV lamps, sourcemeters/picoammeter, autoclaves, galvanostat/potentiostat system, 3D printer, thermal camera.



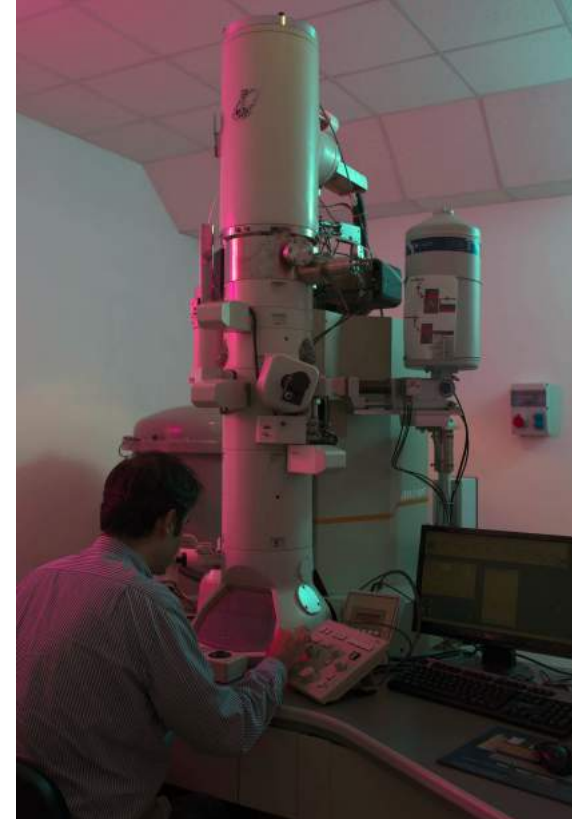
Novel Alloys Design and Development Laboratory

The group is mainly focused on design, development and analysis of multicomponent intermetallic and metallic glass alloy systems which include nanoalloys, bulk amorphous and bulk nanocrystalline alloy systems. These studies are mostly supplemented with modeling and simulations to reveal atomistic mechanisms governing structure-property-performance relationships for alloys in consideration.

Our computational tools involve several workstations with first-principle calculation softwares such as abinit and Medea-Vasp, Molecular Dynamics and Monte Carlo packages and in-house electronic calculation, simulation and data analyses algorithms. Our group has a solid background in theoretical investigations of order-disorder and related phenomena in binary and ternary alloy systems. With our computational capabilities, we intend to compare/contrast such phenomena under finite surface conditions of nanoalloy forms also.

Major devices used in the laboratory:

Arc-melting and suction casting equipment, centrifugal casting equipment, differential scanning calorimeter (DSC), vibrating sample calorimeter (VSM), ball mill, muffle and elevator furnaces.



Photocatalytic Materials Laboratory

The group is focused on the synthesis and production of photocatalytic materials and evaluation of their photocatalytic properties. The studies of interest include self cleaning applications, dye sensitized solar cells (DSSC), antibacterial coatings, dental materials.

Major devices used in the laboratory:

Planetary ball mill, centrifuge, spectrophotometer, autoclave, Pin-on-disk type tribometer, light sources/UV lamps.

Polymers and Nanocomposites Laboratory

The group is focused on the production and characterization of various polymer based nanocomposites using industrially-compatible processing methods for engineering applications such as cable industry, electrical appliances industry, automotive industry.

Major devices used in the laboratory:

Twin-screw extruder for compounding, injection molding device, laboratory scale compression molding device, ball milling and screening system.



Solid Mechanics and Metal Forming Laboratory

The group is focused on the observation of the in-situ formation and evolution of the surface defects during metal sheet forming by means of a novel test mechanism involving high-resolution photography and digital image correlation (DIC) techniques. As an alternative to conventional macro-scale tests, we investigate the mechanical behavior of materials at microstructure scale (grain-scale). Interactions between microstructure evolution and defect formation will be analyzed, which results in solutions for will defect minimization and elimination during metal forming.

Major devices used in the laboratory:

Bending test machine, lens setup, rework station, CCD camera, light sources, cupping machine.



Structure and Dynamics in Metals Laboratory

The group is primarily focused on understanding the dynamical evolution and structural hierarchy at different length scales and controlling the phase selection mechanisms under far-from-equilibrium conditions in metallic systems. Area of interest include, but not limited to, amorphous and nanocrystalline metallic alloys, lead-free solders, RE-free magnets, superaustenitic stainless steel and single crystal growth.

Major devices used in the laboratory:

Quartz/Pyrex sealing system, thermal-shock Instrument, arc-melting, induction casting, 3D printers, various annealing furnaces, glove box, ball mill, hydraulic press, VASP, Thermocalc software.



Surface Science Research Laboratory

The group is focused on production and characterization of micron-and nanoscale inorganic and metallic structures to be integrated into micro-electronic, optical and mechanical systems, solar cells and thermoelectric modules.

Major devices used in the laboratory:

Ferroelectric tester (Radiant), mercury probe, optical microscope, scanning thermometer, high current source, sensitive digital voltmeter, nanovoltmeter, temperature control unit, 4 point measurement system, microwave oven, sputter coating system, thermoelectric measurement system.

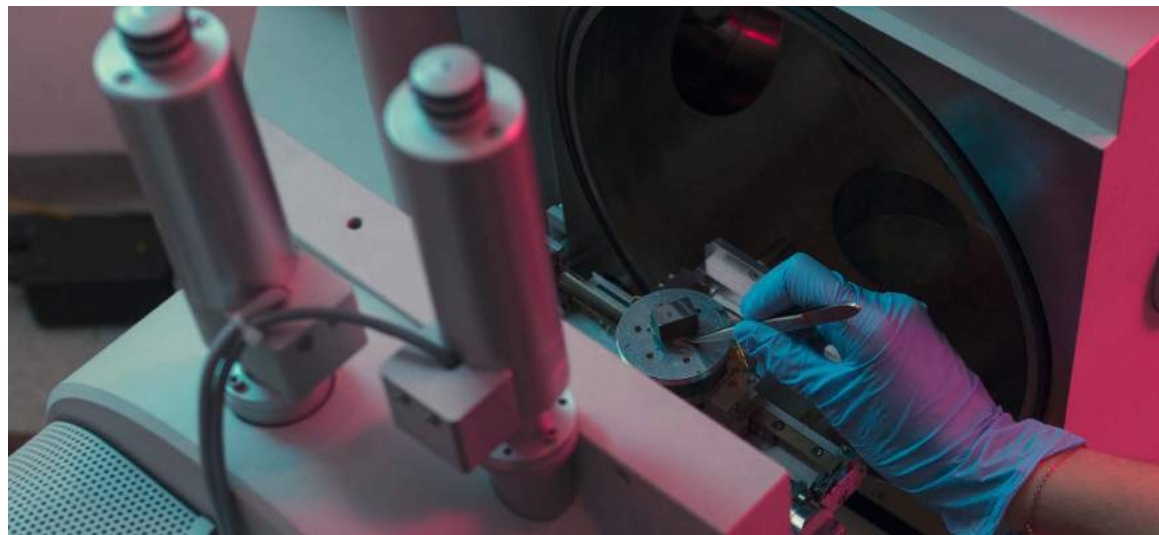


Thermochemical and Electrochemical Materials Processing Laboratory

The group is focused on materials production, processing and properties that involve thermochemical and electrochemical applications. The theoretical and the experimental work on different kinds of energy exchanges accompanying production and processing reactions of materials are covered in thermochemical studies. Molten salt electrolysis, electrodeoxidation and electrowinning processes for metal production and electroforming, electroplating, electromachining and electropolishing in aqueous solutions are covered in electrochemical studies.

Major devices used in the laboratory:

Potentiostat/galvanostat system, X-ray fluorescence (XRF), power supplies, gas mixing and analyzing equipment, digital microscope, profilometer, deposit stress analyzer.



Educational Service Laboratories

Ceramic Engineering Laboratories

Ceramic Engineering Laboratories are a facility dedicated to powder comminution, ceramic powder processing through chemical routes, rheological characterization for the study of ceramic slurries and colloidal behavior, glass melting and crystallization, structural studies and thermal, mechanical, electrical and magnetic characterization of ceramics.

Major devices used in the laboratory:

Ceramic ball mills, slip casting, pressing, CIP and extrusion units, vacuum or pressure sintering furnaces up to temperatures of 2500°C, glass melting and crystallization facilities, equipment for structural studies and for the characterization of thermal, mechanical, electrical, and magnetic properties of ceramics.



Electron Microscopy Laboratories

The department has both SEM and TEM facilities for materials characterization. Facilities for sample preparation complements electron microscopy laboratories.

Major devices used in the laboratory:

A field emission SEM. FEI Nova Nano SEM 430 with a variety of detectors; Helix, vCD, STEM. This microscope is equipped with EDS analysis system and EBSD camera integrated to a common platform (PEGASUS) allowing local elemental analysis as well as phase and texture analysis, a 40 kV Jeol 6400 SEM equipped with digital imaging and Noran Inst. Series II X-ray microanalyser, a field emission TEM: JEOL JEM-2100F UHR/HRP 200 kV Microscope with 0.19 nm resolution equipped with STEM, EDS spectrophotometer and high resolution CCD camera, a 100 kV JEOLTEM100 CX transmission electron microscope. Sample preparation facility includes disc cutter, dimpling grinder, automatic twin jet polisher, ion mill, plasma cleaner, gold sputter coater.



Extractive Metallurgy Laboratory

Extractive Metallurgy Laboratory is a facility dedicated for raw material preparation, metal extraction and refining consisting of individual hydrometallurgy and pyrometallurgy laboratories.

Major devices used in the laboratory:

Equipment for atmospheric leaching, Parr titanium autoclaves, pH meters, various types of filters, electrowinning equipment, magnetic separator, flotation units, solvent extraction and ion exchange units, semi-pilot scale equipment for extraction and refining, a pelletizing disc, fluidized bed roaster, Herreshoff roasting unit, various muffle and tube furnaces, a high frequency induction furnace and an electric arc furnace (Birlec-100 kVA), oxygen probe/oxygen analyzer.

Foundry and Alloy Preparation Laboratory

Foundry and Alloy Preparation Laboratory: is a facility dedicated to melting and alloying as well as casting of various alloys.

Major devices used in the laboratory:

Inductotherm magnethermic motor generator coreless induction furnace has a melting capacity of 10 kg aluminum alloy and 16-17 kg cast iron can be used to melt both ferrous and nonferrous alloys, Inductotherm minimelt induction furnace has a capacity of melting 25 kg ferrous alloy, Indemak coreless induction furnace has a melting capacity of 150 kg steel and cast iron, PLC controlled automatic hydraulic vertical squeeze casting press having 100 Tons locking and 70 Tons injection pressure for aluminum and metal matrix composite part production, 200 ton capacity pressure die casting machine, 15 ton capacity thixocaster, resistance heating furnace for melting and holding of aluminum alloys having capacity of 300 kg is available for aluminum pressure die and squeeze casting, drop bottom hydraulic atmosphere controlled industrial scale computer controlled programmable heat treatment and brazing furnace, drop bottom hydraulic industrial scale computer controlled programmable tempering heat treatment furnace, fuel fired furnaces, centrifugal casting machine, sand casting flasks, electro-slag remelting unit, DC driver controlled 300 mm dia rolling, spray rolling and twin roll casting machine, foundry-master optical emission spectrometer device working with CCD technology.



Heat Treatment Laboratory

Heat Treatment Laboratory is a facility dedicated for heat treatment of various types of materials.

Major devices used in the laboratory:

Various muffle and tube furnaces that can operate under controlled atmospheres and vacuum. Salt baths are available for different heat treatment applications.



Instrumental Analysis and Wet Chemical Analysis Laboratory

Instrumental Analysis and Wet Chemical Analysis Laboratory is a facility dedicated to carbon, sulfur, oxygen, hydrogen and nitrogen analysis in ferrous and non-ferrous alloys. Standard equipment for volumetric and gravimetric wet chemical analyses are also available.

Major devices used in the laboratory:

Perkin Elmer Atomic Absorption Spectrophotometer, Perkin-Elmer Gas Chromatograph, Satmagan magnetite analyzer, pH meter, a spectrometer, two photometers, turbidimeters and Leco for analysis of carbon, sulfur, oxygen, hydrogen and nitrogen.



Machine Shop

Machine Shop is a facility that serves to implement the research needs of faculty members and graduate students.

Major devices used in the laboratory:

Lathes, a milling machine, a surface grinding machine, a shaping machine, various drills, and various welding equipment.



Mechanical Testing Laboratory

Mechanical Testing Laboratory is a facility dedicated for the mechanical characterization of different materials including thin sheets, composites, polymers and ceramics.

Major devices used in the laboratory:

A INSTRON 5582 Universal Testing Machine, 10 ton capacity with high-temperature furnace attachment and optical strain analysis, a INSTRON 5565A Universal Testing Machine with 0.5 ton capacity and miniature scale testing ability and optical strain analysis, various load cells and load indicators, a 10 ton MTS Universal Testing System for testing under controlled load, deflection or strain for fatigue, creep and stress relaxation studies, a 60 ton capacity ALSA hydraulic tension-compression-bending testing machine, a 25 ton Dartec Universal Dynamic Testing Machine for tension, compression, bending and fatigue tests, a crack monitoring system for fracture toughness and fatigue crack kinetics tests, a TINIUS-OLSEN pendulum type Charpy impact tester, a desktop pendulum impact tester for ceramic, composite and polymeric materials, furnaces and cooling systems for impact testing at high and low temperatures, EMCO universal hardness tester for Brinell, Vickers and Rockwell measurements. a student type creep testing device and rotating beam fatigue testing machines.



Metallography and Image Analysis Laboratory

Metallography and Image Analysis Laboratory: is a facility dedicated to metallographic sample preparation, optical microscopy, hardness test and automated grain size, aspect ratio, volume fraction, nodule count and sphericity as well as graphite size distribution determination.

Major devices used in the laboratory:

Specimen cutting and mounting, mechanical and electrolytic polishing, macro and micro etching facilities. Various optical microscopes namely Nikon, Olympus and Vickers research microscopes with digital camera attachments, microhardness tester with Vickers and Knoop indenters, Clemex Image Analysis System.



Nondestructive Testing Laboratory

Nondestructive Testing Laboratory is a facility dedicated for nondestructive testing and evaluation of materials using various methods.

Major devices used in the laboratory:

Facilities for liquid penetrant, magnetic particle methods, radiography with X-rays units (150 kV and 300 kV), analog and digital ultrasonic testing equipment with various probes in the frequencies of 2 and 4 MHz.

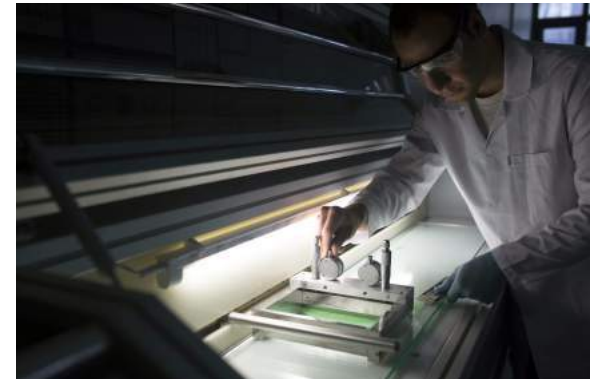


Powder Metallurgy Laboratory

Powder Metallurgy Laboratory is a facility dedicated for powder processing and compaction.

Major devices used in the laboratory:

Sieve shaker unit and standard set of sieves, a sintering furnace that can reach up to 1350°C and a manual hydraulic press for the formation of powder compacts.



Thermal Analysis Laboratory

Thermal Analysis Laboratory: is a facility dedicated for thermal analysis, quantitative and qualitative calorimetric studies.

Major devices used in the laboratory:

Setaram DSC 131 thermal analyzer for temperatures of -170 °C to 600 °C, Setaram SETSYS TG-DTA/DSC thermal analyzer with facilities for simultaneous TG and DTA/DSC measurements for temperatures from ambient to 1650°C.



Undergraduate Processing and Research Laboratory

Undergraduate Processing and Research Laboratory is a facility dedicated to undergraduate laboratory and research classes, as well as senior design projects. Wet chemical processing, thermo-mechanical processing, polymer processing and ceramic/powder processing is possible in these laboratories.

Major devices used in the laboratory:

Drying ovens and furnaces, hot plates, pH meters, ultrasonic cleaners, precision balance, hydraulic press, spin coater, twin-screw extruder, sintering furnace.

Welding Technology Laboratory

Welding Technology Laboratory is a facility dedicated for various welding operations such as gas welding, manual metal arc welding, MIG/MAG, TIG, spot welding and hybrid plasma arc welding.

Major devices used in the laboratory:

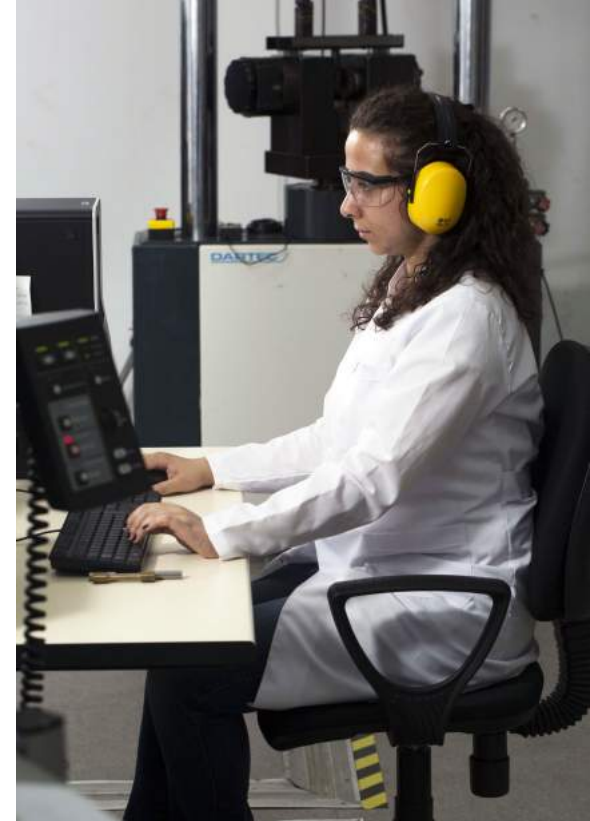
Conventional welding process equipment for gas welding, manual metal arc welding, MIG/MAG, TIG and spot welding, hot cracking test (MVT-test), cold cracking test (implant test), hybrid plasma arc welding and 3-axis CNC milling machine for sample preparation.

X-Ray Laboratory

X-Ray Laboratory has three diffractometers for materials characterization.

Major devices used in the laboratory:

Rigaku D/MAX 2200 ULTIMA/PC equipped with theta-theta goniometer with multi-purpose sample attachment allowing a variety of measurements including texture and residual stress, Rigaku DMAX/IIIC Diffraction unit with theta-2-theta goniometer, Bruker D8 Advance equipped with Anton Paar HTK 16N hot stage capable of measurements up to 1500 °C



Faculty



Vedat Akdeniz

Professor of Metallurgical and Materials Engineering

Ph.D: The Open University, Dept. of Materials Sci. and Engineering, 1989

M.S: Middle East Technical University, Dept. of Metallurgical Engineering, 1986

B.S: Middle East Technical University, Dept. of Metallurgical and Materials Engineering, 1983

RESEARCH AREA:

Amorphous/Glassy Metallic Alloys, Nanocrystalline Materials, Intermetallics, Interfaces and Interfacial Reactions

SELECTED PUBLICATIONS:

- R. Eris, A. O. Mehrobov, M.V. Akdeniz, High temperature site preference and atomic short range ordering characteristics of ternary alloying elements in gamma Ni₃Al intermetallics, Philosophical Magazine, 97 (2017) 2615-2631.
- M. Yildirim, M.V. Akdeniz, A.O. Mekhrabov, Microstructural evolution and room-temperature mechanical properties of as-cast and heat-treated Fe₅₀Al(50-n)Nb(n) alloys (n=1, 3, 5, 7, and 9 at%), Material Science and Engineering: A, 664 (2016) 17-25.
- N. Duman, A.O. Mekhrabov, M.V. Akdeniz "Magnetic Monitoring Approach to Nanocrystallization Kinetics in Fe-based Bulk Amorphous Alloy, Intermetallics, 43 (2013) 152-161.



M. Kadri Aydınol

Professor of Metallurgical and Materials Engineering

Ph.D: Middle East Technical University, Dept. of Metallurgical and Materials Engineering, 1994

M.S: Middle East Technical University, Dept. of Metallurgical and Materials Engineering, 1991

B.S: Middle East Technical University, Dept. of Metallurgical and Materials Engineering, 1989

RESEARCH AREA:

Atomistic Computer Modeling of Materials: ab-initio Methods, Monte Carlo and Molecular Dynamics Simulations. Energy Storage Materials and Devices: Lithium-ion, Ni-MH, Lead-acid and Silver-Zinc Batteries, Hydrogen Storage Alloys and Compounds, Electrochemistry of Materials: Corrosion of Materials and Corrosion Testing and Control.

SELECTED PUBLICATIONS:

- B. Piskin, M.K. Aydınol, Development and characterization of layered Li(Ni(x)Mn(y)Co(1-x-y))O₂ cathode materials for lithium ion batteries, International Journal of Hydrogen Energy, 41 (2016) 9852-9859.
- A. Buyukburç, M.K. Aydınol, Effect of Cr and Mo doping on the electrochemical properties of freeze-dried LiCoO₂, International Journal of Materials Research, 105 (2014) 983.
- A. Büyükburç and M.K. Aydınol, Effect of Cr and Mo doping on the electrochemical properties of freeze-dried LiCoO₂, International Journal of Materials Research, 105 (2014) 983.



Arcan Fehmi Dericioğlu

Professor of Metallurgical and Materials Engineering

Postdoc/Res. Exp.: National Institute for Materials Science and Institute of Industrial Science

Ph.D: The University of Tokyo, Dept. of Materials Science, 2002

M.S: Middle East Technical University, Dept. of Metallurgical and Materials Engineering, 1999

B.S: Middle East Technical University, Dept. of Metallurgical and Materials Engineering, 1997

RESEARCH AREA:

Interaction of Electromagnetic Radiation with Matter, Electromagnetic Wave Absorbing Materials, High Frequency Transformer Materials, Optical and Optomechanical Composites, Nanostructured Multilayer Composites, Natural Composites, Bio-Inspired Composites, Interfaces, Mechanical Properties.

SELECTED PUBLICATIONS:

- G.M. Bilgin, Z. Esen, S.K. Akin, A.F. Dericioğlu, Optimization of the mechanical properties of Ti-6Al-4V alloy fabricated by selective laser melting using thermohydrogen processes, Materials Science and Engineering A, 700 (2017) 574-582.
- E. Tan, Y. Kagawa, A.F. Dericioğlu, Electromagnetic Wave Absorption Potential of Si-C Based Ceramic Woven Fabrics, Journal of Materials Science, 44 (2009) 1172-9.

Faculty



Caner Durucan

Professor of Metallurgical and Materials Engineering

Ph.D: Pennsylvania State University, Dept. of Materials Sci. and Engineering, 2003

M.S: Pennsylvania State University, Dept. of Materials Sci. and Engineering, 1998

B.S: Middle East Technical University, Dept. of Metallurgical and Materials Engineering, 1993

RESEARCH AREA:

Biomedical Materials, Bioceramics, Calcium Phosphates, Glass Surfaces, Interfaces and Coatings, Sol-Gel Chemistry (silicates, organic-inorganic hybrid systems).

SELECTED PUBLICATIONS:

- D. Kapusuz, C. Durucan, Exploring encapsulation mechanism of DNA and mononucleotides in sol-gel derived silica, *Journal of Biomaterials Applications*, 32 (2017) 114-125.
- O.A. Yildirim, C. Durucan, Room temperature synthesis of Cu incorporated ZnO nanoparticles with room temperature ferromagnetic activity: Structural, optical and magnetic characterization, *Ceramics International* 42 (2016) 3229-3238.
- H. Yavas, C.D. Ozturk Selcuk, A.E.S. Ozhan, C. Durucan, A parametric study on processing of scratch resistant hybrid sol-gel silica coatings on polycarbonate, *Thin Solid Films* 556 (2014) 112-119.



C. Hakan Gür

Professor of Metallurgical and Materials Engineering

Ph.D: Middle East Technical University, Dept. of Metallurgical and Materials Engineering, 1995

M.S: Middle East Technical University, Dept. of Metallurgical and Materials Engineering, 1989

B.S: Middle East Technical University, Dept. of Metallurgical and Materials Engineering, 1986

RESEARCH AREA:

Nondestructive Testing and Materials Characterization, Determination of Residual Stresses, Heat Treatment, Welding

SELECTED PUBLICATIONS:

- Handbook of Thermal Process Modeling of Steels, (Editors: C. Hakan Gür, J.S. Pan), 2009 CRC-Press, ISBN 978-0-8493-5019-1
- K. Davut, C.H. Gür, Monitoring the Microstructural Evolution in Spheroidized Steels by Magnetic Barkhausen Noise Measurements, *J Nondestructive Evaluation*, 29 (2010) 241-247
- I. Yelbay, I. Çam, C.H. Gür, Non Destructive Determination of Residual stress State in Steel Weldments by Magnetic Barkhausen Noise Technique, *NDT&E International*, 43 (2010) 29-33
- C.H. Gur, Review of Residual Stress Measurement by Magnetic Barkhausen Noise Technique, *Materials Performance and Characterization*, 7 (2018) 1-22.



Rıza Gürbüz

Professor of Metallurgical and Materials Engineering

Ph.D: Middle East Technical University, Dept. of Metallurgical and Materials Engineering, 1987

M.S: Middle East Technical University, Dept. of Metallurgical and Materials Engineering, 1982

B.S: Middle East Technical University, Dept. of Metallurgical and Materials Engineering, 1979

RESEARCH AREA:

Failure Analysis, Fatigue Crack Growth, Fracture and Fatigue Behavior of Railway Rails and Wheels, Mechanical Testing

SELECTED PUBLICATIONS:

- G. Cevik, R. Gurbuz, Evaluation of fatigue performance of a fillet rolled diesel engine crankshaft, *Engineering Failure Analysis*, 27 (2013) 250-261.
- K. Yurtşik, S. Tirkeş, D. Igor., C.H. Gür, R. Gürbüz, Characterization of duplex stainless steel weld metals obtained by hybrid plasma –gas-metal arc welding, *Revista Soldagem & Inspeção*, 18 (2013) 207-216.
- E. Varlı, R. Gürbüz, Fatigue Crack Growth Behavior of 6013 Al-Alloy at different Aging Conditions in Two Orientations, *Turkish J. Eng. Env. Sci.* 30 (2006) 381-386.
- R. Gürbüz, A. Kalkanlı, H. Gönenç, Effect of Cu alloying on fatigue life and fatigue crack growth behavior of ductile cast irons, *Canadian Metallurgical Quarterly*, 43 (2004) 137-144.

Faculty



Ali Kalkanlı

Professor of Metallurgical and Materials Engineering

Postdoc/Res. Exp.: The University of Nottingham

Ph.D: The Open University Milton Keynes, Materials Engineering and Design, 1993

M.S: Middle East Technical University, Dept. of Metallurgical and Materials Engineering, 1985

B.S: Middle East Technical University, Dept. of Metallurgical and Materials Engineering, 1982

RESEARCH AREA:

Aluminum matrix composites, squeeze casting, pressure die casting, thixocasting, alloy powder extrusion for high temperature, aluminum extrusions for car chassis, tool steel, casting, heat treatment and brazing, compact and spheroidal graphite, cast irons, thermal analysis and casting simulation.

SELECTED PUBLICATIONS:

- O. Dincer, M.K. Pehlivanoglu, N.K. Caliskan, I. Karakaya, A. Kalkanli, Processing and microstructural characterization of liquid phase sintered tungsten-nickel-cobalt heavy alloys. International Journal of Refractory Metals and Hard Materials, 50 (2015) 106-112.
- E. Koraman, M. Baydogan, S. Sayilgan, A. Kalkanli, Dry sliding wear behaviour of Al-Fe-Si-V alloys at elevated temperatures. Wear, 322-323 (2015) 101-107.



Ishak Karakaya

Professor of Metallurgical and Materials Engineering

Postdoc/Res. Exp.: McGill University and Royal Military College

Ph.D: McGill University, Dept. of Metallurgical and Materials Engineering, 1985

M.S: McGill University, Dept. of Metallurgical and Materials Engineering, 1981

B.S: Middle East Technical University, Dept. of Metallurgical and Materials Engineering, 1978

RESEARCH AREA:

Thermochemistry of Molten Oxide, Salt and Alloy Systems, Electrometallurgy of Light Metals, High Temperature Corrosion of Alloys, Computer Modelling of Phase Diagrams

SELECTED PUBLICATIONS:

- B. Arslan, N. Ülgüdür, M. Erdoğan, İ. İmamoğlu, İ. Karakaya, Comparison of Structural Properties of Copper Deposits from Sulfate and Pyrophosphate Electrolytes, ECS Trans. 58 (2014) 105-113.
- E. Saraloğlu Güler, İ. Karakaya, E. Konca, Effects of current density, coating thickness on internal stress during Ni-MoS₂ electrocodeposition, Surface Engineering, 30 (2014) 109-114.
- M. Erdoğan, İ. Karakaya, On the Electrochemical Reduction Mechanism of CaWO₄ to W Powder, Metallurgical and Materials Transactions B, 43 (2012) 667-670.



Cevdet Kaynak

Professor of Metallurgical and Materials Engineering

Postdoc/Res. Exp.: Cambridge University, 1996

Ph.D: Middle East Technical University, Dept. of Metallurgical and Materials Engineering, 1994

Ph.D: London Imperial College, Dept. of Metallurgical and Materials Engineering, 1994

M.S: Middle East Technical University, Dept. of Metallurgical and Materials Engineering, 1988

B.S: Middle East Technical University, Dept. of Metallurgical and Materials Engineering, 1985

RESEARCH AREA:

Development of Polymer Based Nanocomposites for Engineering Applications

SELECTED PUBLICATIONS:

- I. Kaygusuz, C. Kaynak, Influences of Halloysite Nanotubes on Crystallisation Behaviour of Polylactide, Plastics, Rubber and Composites: Macromolecular Engineering, 44 (2015) 41-49 .
- C. Kaynak, Y. Meyva, Use of Maleic Anhydride Compatibilization to Improve Toughness and Other Properties of Polylactide Blended with Thermoplastic Elastomers, Polymers for Advanced Technologies, 25 (2014) 1622-1632.
- A.R. Erdogan, I. Kaygusuz, C. Kaynak, Influences of Aminosilicization of Halloysite Nanotubes on the Mechanical Properties of Polyamide-6 Nanocomposites, Polymer Composites, 35 (2014) 1350-1361.

Faculty



Amdullah Mekhrabov

Professor of Metallurgical and Materials Engineering

Postdoc/Res. Exp.: Lomonosov Moscow State University and Tokyo University and University of California

D.Sc.: Tbilisi State University, Solid State Physics and Materials Science, 1989

Ph.D.: Lomonosov Moscow State University, Solid State Physics, 1978

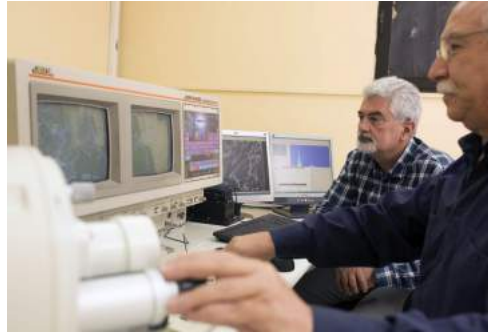
B.S.: Azerbaijan State University, Dept. of Physics, 1974

RESEARCH AREA:

Development of Polymer Based Nanocomposites for Engineering Applications

SELECTED PUBLICATIONS:

- M. Yildirim, M.V. Akdeniz, A.O. Mekhrabov, Effect of Ternary Alloying Elements Additions on the Order-Disorder Transformation Temperatures of B2-Type Ordered Fe-Al-X Intermetallics, *Metallurgical and Materials Transactions A*, 43A (2012) 1809-1816.
- M. Yildirim, M.V. Akdeniz, A.O. Mekhrabov, Microstructural evolution and room-temperature mechanical properties of as-cast and heat-treated Fe₅₀Al_(50-n)Nb_(n) alloys (n=1, 3, 5, 7, and 9 at%), *Material Science and Engineering: A*, 664 (2016) 17-25.
- M. Yildirim, M.V. Akdeniz, A.O. Mekhrabov, Microstructural Investigation and Phase Relationships of Fe-Al-Hf Alloys, *Metallurgical and Materials Transactions A*, 45A (2014) 3412-3421.



Bilgehan Ögel

Professor of Metallurgical and Materials Engineering

Ph.D.: Middle East Technical University, Dept. of Metallurgical and Materials Engineering, 1990

M.S.: Middle East Technical University, Dept. of Metallurgical and Materials Engineering, 1984

B.S.: Middle East Technical University, Dept. of Metallurgical and Materials Engineering, 1982

RESEARCH AREA:

Microstructure-Property Relationships Failure Analysis and Heat Treatment of Metals, Powder Metallurgy

SELECTED PUBLICATIONS:

- M. Ubeyli, R.O. Yildirim, B. Ogel, Investigation on the ballistic behavior of Al₂O₃/Al₂O₂₄ laminated composites, *Journal of Materials Processing Technology*, 196 (2008) 356-364.
- M. Ubeyli, A. Acir, M.S. Karakas, B. Ogel, Effect of Feed Rate on Tool Wear in Milling of Al-4% Cu/B4Cp Composite, *Materials and Manufacturing Processes*, 23, (2008) 865-870.
- M. Ubeyli, R.O. Yildirim, B. Ogel, On the comparison of the ballistic performance of steel and laminated composite armors, *Materials and Design*, 28 (2007) 1257-1262.
- B. Ogel, R. Gurbuz, F. Bedir, Age Hardening Behaviour and Mechanical Strength of Al-TiC Composites Produced by Conventional Hot Pressing Method. *Metall.*, 7-8, (2005) 459-462.



Abdullah Öztürk

Professor of Metallurgical and Materials Engineering

Ph.D.: University of Missouri Rolla, Dept. of Ceramic Eng., 1991

M.S.: University of Missouri Rolla, Dept. of Ceramic Eng., 1987

B.S.: Istanbul Technical University, Dept. of Metallurgical Engineering, 1983

RESEARCH AREA:

Production, Properties and Characterization of Ceramics, Glasses and Glass Ceramics, Ceramic Matrix Composites

SELECTED PUBLICATIONS:

- O. Agac, M. Gozutok, H. Turkoglu Sasmazel, J. Park, A. Ozturk, Mechanical and Biological Properties of Al₂O₃ and TiO₂ Codoped Zirconia Ceramics, *Ceramics International*, 43 (2017) 10434-10441.
- N. Erdogan, A. Ozturk, J. Park, Hydrothermal synthesis of 3D TiO₂ nanostructures using nitric acid: Characterization and evolution mechanism, *Ceramics International*, 42 (2016) 5985-5994.
- N. Bilgin, J. Park, A. Ozturk, Influence of Particle Size of TiO₂ powder on the energy conversion efficiency of Dye-Sensitized Solar Cell, *Adv. Mat. Res.*, 650 (2013) 39-43.
- J. Park, A. Ozturk, Bioactivity of Apatite-Wollastonite Glass-Ceramics produced by Melt Casting, *Surf. Rev. and Lett.*, 20 (2013) 1350010-1350017.
- T. Tokmakci, A. Ozturk, J. Park, Boron-Zirconium Co-doped TiO₂ Powders Prepared Through Mechanical Ball Milling, *Cer. Int.*, 39 (2013) 5893-5899.

Faculty



Tayfur Öztürk

Professor of Metallurgical and Materials Engineering

Ph.D: Cambridge University, Metallurgy and Materials Science, 1978

B.S: Istanbul Technical University, Dept. of Metallurgical Engineering, 1973

RESEARCH AREA:

Energy Storage Materials, metal hydrides, Hydrogen separation membranes, Nanoporous materials, nanostructured materials via thin film processing and mechanical milling, nanopowder synthesis via thermal plasma

SELECTED PUBLICATIONS:

- S. Dogancan, Z.C. Torunoglu, Y.E. Kalay, T. Ozturk, Preparation of La 0.8 Sr 0.2 CoO 3-d sputtering targets using a deformable compaction die, *Ceramics International*, 43 (2017) 15185.
- F. Pişkin, T. Öztürk, Combinatorial screening of PdAgNi membranes for hydrogen separation, *Journal of Membrane Science*, 524 (2017) 631.
- B. Aktekin, C. Eyogve, T. Ozturk, Carbon coating of magnesium particles, *Journal of Alloys and Compounds*, 720 (2017) 17.
- S. Tan, Y. Shen, E.O. Sahin, D. Noréus, T. Ozturk, Activation behavior of an AB₂ type metal hydride alloy for NiMH batteries, *International Journal of Hydrogen Energy* 41 (2016) 9948-9953.



H. Emrah Ünal

Professor of Metallurgical and Materials Engineering

Postdoc/Res. Exp.: University of Cambridge, 2008

Ph.D: Rutgers University, Materials Science and Engineering, 2006

M.S: Rutgers University, Materials Science and Engineering, 2004

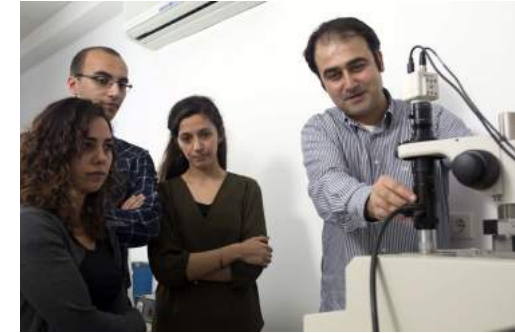
B.S: Middle East Technical University, Dept. of Metallurgical and Materials Engineering, 2002

RESEARCH AREA:

Transparent, Flexible and Stretchable Electronics, Organic Electronics and Semiconducting Devices, Nanowires and Carbon Nanotubes, Solar cells, Light Emitting Diodes and Batteries

SELECTED PUBLICATIONS:

- R. Yuksel, S. Coskun, Y. E. Kalay, H. E. Unalan, Flexible, Silver Nanowire Network Nickel Hydroxide Core-Shell Electrodes For Supercapacitors, *J. Power Sources* 328 (2016) 167-173.
- R. Yuksel, Z. Sarioba, A. Cirpan, P. Hiralal, H.E. Unalan, Transparent and flexible supercapacitors with single walled carbon nanotube thin film electrodes, *ACS Appl. Mater. Interfaces* 6 (2014) 15434.
- S. Coskun, E.S. Ates, H.E. Unalan, Optimization of Silver Nanowire Networks for Polymer Light Emitting Diode Electrodes, *Nanotechnology* 24 (2013) 125202.



Y. Eren Kalay

Associate Professor of Metallurgical and Materials Engineering

Postdoc/Res. Exp.: Ames Laboratory and Argonne National Laboratory

Ph.D: Iowa State University, Materials Science and Engineering, 2009

M.S: Middle East Technical University, Dept. of Metallurgical and Materials Engineering, 2003

B.S: Middle East Technical University, Dept. of Metallurgical and Materials Engineering, 2001

RESEARCH AREA:

Scanning and transmission electron microscopy and spectroscopy, Synchrotron X-ray scattering, Phase transformations under far-from equilibrium conditions, Glass and nanocrystal forming metallic alloy systems Electronic packaging, High Entropy Alloys, RE-free magnetic alloy systems.

SELECTED PUBLICATIONS:

- Kalay, Y.E. Kalay, I., Hwang, J., Voyles, P.M., Kramer, M.J., Local chemical and topological order in Al-Tb and its role in controlling nanocrystal formation *Acta Materialia*, 60, 3, 994-1003, 2012.
- Hwang, J., Melgarejo, Z.H., Kalay, Y.E., Kalay, I., Kramer, M.J., Stone, D.S., Voyles, P.M., Nanoscale structure and structural relaxation in Zr₅₀Cu₄₅Al₅ bulk metallic glass, *Physical Review Letters*, 108, 19, 195505, 2012.

Faculty



Simge Çınar

Assistant Professor of Metallurgical and Materials Engineering

Postdoc/Res. Exp.: Materials Science and Engineering, Iowa State University, Mechanical Engineering, Iowa State University, 2014 - 2016

Ph.D: Iowa State University, Materials Science and Engineering, 2013

M.S: Middle East Technical University, Dept. of Chemical Eng., 2009

B.S: Middle East Technical University, Dept. of Chemical Eng., 2008

RESEARCH AREA:

Colloidal Materials, Surface and Interface Science, Nanomaterial Synthesis, Functional Materials, Rheology

SELECTED PUBLICATIONS:

- S. Çınar, I.D. Tevis, J. Chen, M. Thuo, Mechanical Fracturing of Core-Shell Undercooled Metal Particles for Heat-Free Soldering, *Scientific Reports*, 6 (2016) 21864.
- E. Fırlar, S. Çınar, S. Kashyap, M. Akinc, T. Prozorov, Direct Visualization of the Hydration Layer on Alumina Nanoparticles with the Fluid Cell STEM in situ, *Scientific Reports*, 5 (2015) 9830.
- S. Çınar, D. Anderson, M. Akinc, Influence of Bound Water Layer on the Viscosity of Oxide Nanopowder Suspensions, *Journal of European Ceramic Society*, 35 (2015) 613-22.



Mert Efe

Assistant Professor of Metallurgical and Materials Engineering

Postdoc/Res. Exp.: Purdue University and Convolutus Inc.

Ph.D: Purdue University, Dept. of Materials Engineering, 2012

M.S: Purdue University, Dept. of Materials Engineering, 2008

B.S: Middle East Technical University, Dept. of Metallurgical and Materials Engineering, 2005

RESEARCH AREA:

Experimental Solid Mechanics and Deformation Processing (Light weight Alloys, Refractory Metals), Irradiation Effects on Metals (Tungsten), Powder Metallurgy (Refractory Metals: Tungsten, Tantalum), Material Processing & Manufacturing Economics

SELECTED PUBLICATIONS:

- M. Efe, O. El-Atwani, Y. Guo, D.R.Klenosky, Microstructure Refinement of Tungsten by Surface Deformation for Irradiation Damage Resistance, *Scripta Materialia*, 70 (2014) 31-34.
- D. Sagapuram, M. Efe, W. Moscoso, K.P. Trumble, S. Chandrasekar, Controlling Texture in Magnesium Alloy Sheet by Shear-based Deformation Processing, *Acta Materialia*, 61 (2013) 6843-6856.
- M. Efe, H.J. Kim, S. Chandrasekar, K.P. Trumble, The chemical state and control of oxygen in powder metallurgy tantalum, *Material Science and Engineering A*, 544 (2012) 1-9.
- Y. Seymen, B. Guler, M. Efe, Large Strain and Small-Scale Biaxial Testing of Sheet Metals, *Experimental Mechanics*, 56 (2016) 1-12.



Batur Ercan

Assistant Professor of Metallurgical and Materials Engineering

Postdoc/Res. Exp.: Harvard Medical School and Northeastern University

Ph.D: Brown University, Biomedical Engineering, 2011

M.S: Purdue University, Materials Engineering, 2005

B.S: Middle East Technical University, Dept. of Metallurgical and Materials Engineering, 2003

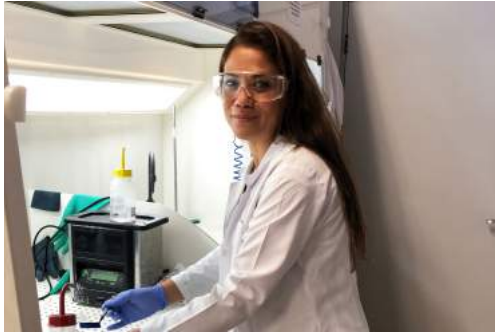
RESEARCH AREA:

Nanomaterials, Material Surface Treatments and Coatings, Biomaterials, Nanomedicine, Tissue Engineering

SELECTED PUBLICATIONS:

- S. Chung, B. Ercan, A.K. Roy, T.J. Webster, " Addition of selenium nanoparticles to electrospun silk scaffold improves the mammalian cell activity while reducing bacterial growth". *Frontiers in Physiology*, 7, 297, (2016).
- S. Atefyekta, B. Ercan, J. Karlsson, E. Taylor, S. Chung, T.J. Webster, M. Andersson, "Antimicrobial performance of mesoporous titania thin films: role of pore size, hydrophobicity, and antibiotic release", *International Journal of Nanomedicine*, 11, (2016), 977-990 .
- Z. Karahaloğlu, B. Ercan, E.N. Taylor, S. Chung, E.B. Denkbaz, T.J. Webster, "Antibacterial nanostructured Polyhydroxybutyrate membranes for guided bone regeneration", *Journal of Biomedical Nanotechnology*, 11, 12, (2015), 2253-2263.

Faculty



M. Bilge İmer

Assistant Professor of Metallurgical and Materials Engineering

Postdoc/Res. Exp.: University of California Santa Barbara

Ph.D: University of California Santa Barbara, Materials, 2006

M.S: University of California Santa Barbara, Business Economics, 2006

B.S: University of Pittsburgh (Transferred from Middle East Technical University), Dept. of Materials Science and Engineering, 2000

RESEARCH AREA:

Thin film material (functional coatings, device structure) growth, bulk crystal growth
Device and nano-structured materials clean-room processing, modeling, simulation and testing.

SELECTED PUBLICATIONS:

- B. Imer, S. Nakamura, S. P. DenBaars, J. S. Speck, Polarization anisotropy in GaN films for different nonpolar orientations studied by polarized photoreflectance spectroscopy, Applied Physics Letters. 88 (2006) 161920.
- B. Imer, M. Schmidt, B. Haskell, B. Zhong, Kwang-choong Kim, F. Wu, T. Mates, S. Keller, S. Nakamura, J. S. Speck, S. P. DenBaars, Improved quality nonpolar a-plane GaN/AlGaIn UV LEDs, Physica Status Solidi-a, 205 (2008) 1705-1712.
- B. Imer, J. S. Speck, Steven P. DenBaars, U.S. patent # 20060270076 Defect Reduction of Non-polar {11-20} a- and {1-100} m-plane GaN with Single-Step Sidewall Lateral Epitaxial Overgrowth (SLEO).





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MATERIALS
ENGINEERING

METU Metallurgical and Materials Eng. Dept. mete.metu.edu.tr
Üniversiteler Mah. Dumlupınar Blv. No:1 Phone: +90 312 210 2511
06800 Çankaya / Ankara Türkiye Fax: +90 312 210 2518