Department of Metallurgical and Materials Engineering

http://www.mete.metu.edu.tr
Matters today
Matters tomorrow...
Content


Metallurgical and Materials Engineering

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#1 in ENGINEERING COLLEGE

Metallurgical and Materials Engineering Department is ranked first in Faculty of Engineering based on the number of international articles published in reputable scientific journals per faculty member.

In 2013, we published 56 international journal articles and 43 were SCI indexed.

OUR PROJECTS

As of 2013, there are 28 national projects and 1 international project are being conducted with 520,000 TL yearly budget.
FP7 Marie Curie Project from Mert Efe

Project aims to observe the *in-situ* formation and evolution of the surface defects during magnesium 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, the mechanical behavior of materials will be investigated at microstructure scale (grain-scale). Interactions between microstructure evolution and defect formation will be analyzed, which will result in solutions for defect minimization and elimination.

TURBİTAK 1007: Gas Turbine Blades-MILKANAT

Turbine technology used in gas turbine engines is also utilized in automotive, aviation and space industries. These strategic parts have been imported so far. With this project, however, the turbine technology know-how, infrastructure and development capability will be established in Turkey making it possible to manufacture, do maintenance of, and repair gas turbine blades.

The technology know-how gained in this project, as a result of research and development carried out at METE under the supervision of Asst. Prof. Dr. Bilge Imer, will pave the way for further protective coating developments in other so-called strategic industries. This project started in 2014 with a total budget of 3 million TL allocated to Dr. İmer and METE to carry out turbine blade coating R&D with CVD technique.
LIGHT & ENVIROMENTALLY FRIENDLY CAR PROTOTYPE by
Foundry, Metal Processing and Automotive Materials Laboratory

This project is a graduate research project supporting M.S and P.d.D thesis. Onur Demirel performed his thesis designing an aluminum spaceframe made of aluminum 6061 and Al-Si-Mg alloys. Spaceframe was modelled using Ansys static and dynamic finite element analysis code. Torrntional stiffness of the spaceframe was analyzed under constant amplitude non proportionnal loading conditions.

A clay model was produced then 3D files was obtained after a series of surface operations, A class modeling was completed. Polystyrene ¼ and 1/1 models were produced then a prototype car was assembled a spaceframe using TIG welding of 6061 extrusions and Al%7SiMg T6 alloy.

COLLABORATION OF INDUSTRY AND ‘METE’

The project was funded by Turkish Ministry of Science Industry and Technology and ERTEX company, supervised by Prof. Dr. Ali Kalkanli from Department of Metallurgical and Materials Engineering Middle East Technical University. The chassis and the space-frame of the diesel and electric car prototypes were modelled and produced by casting in our department.

Diesel and electric prototypes were completed and tested on the roads.
**Dr. Kalay received EU support for “Synchrotron X-ray” based Research**

Dr. Kalay’s research group received EU support for their X-ray scattering based experiments in Europe’s prestigious synchrotron light facilities. Dr. Kalay’s team (Merve Genc, Can Yildirim, Mustafacan Kutsal and Fatih Sikan) have conducted critical in-situ XRD and WAXS/SAXS experiments to get the insights of the nucleation and phase selection hierarchy during devitrification of metallic glasses under far-from equilibrium conditions.

Merve Genc (Ph.D. Candidate) at Elettra, Trieste, Italy.

Dr. Kalay at ALBA, Barcelona, Spain.

**and the NOBEL Prize goes to....**

**“Incandescent light bulbs lit the 20th century; the 21st century will be lit by LED lamps.”**

NOBEL COMMITTEE

The invention of blue LED light in 90s by Isamu Akasaki, Hiroshi Amano and Shuji Nakamura has made revolution in energy, communication, defense, space technology and many other fields, and received 2014 Nobel prize in Physics. This has further strengthened the importance of Materials Science and Engineering. Asst. Prof. Dr. Bilge İmer from METU-Metalurgical and Materials Engineering Department worked with Nobel Laureate Prof. Shuji Nakamura, Prof. Steven DenBaars and Prof. James Speck in her PhD at University of California Santa Barbara (UCSB). Under her doctoral study thesis Improved Quality III-Nitride Films and Devices, Dr. İmer filed two patents that are currently in use by LED companies. SOORA, the company Prof. Nakamura is a partner of, has been conducting R&D on LED and lasers also utilizing these patents. In the upcoming years, it will be possible to find high power non-polar blue and green LEDs in the market that uses Dr.İmers work.
Collaborations of Turkish Defense Industries and “METE”

Currently there are several projects that are funded by Turkish Ministry of Science Industry and Technology, Under secretariat for defense Industries (SSM) and Turkish Defense Industries supervised by Prof. İshak Karakaya from Department of Metallurgical and Materials Engineering of Middle East Technical University. Some of the projects are:

Development of Electrochemical Processes for Materials of Optomechanical Carrier of Cooled Infrared Detectors is in progress by collaboration with Aselsan.

Electrochemical Production of Tungsten Refractory Metal Powders and Sintering is in progress by collaboration with ROKETSAN.

MEGAP IS THE FIRST JOINT VENTURE FROM ‘METE’ IN METU TECHNOPOLIS

The invention of an electrochemical process for production of tungsten powder in molten salt solutions has led Prof. İshak Karakaya and a former graduate student Metehan Erdoğan (presently Assist. Prof. at Yıldırım Beyazıt University) from the Department of Metallurgical and Materials Engineering of Middle East Technical University to establish MEGAP to commercialize the process. The process was patented in Turkey, Russia and Canada. Adaptation of process to industrial practice is in progress.

In addition, MEGAP is taking part in Research and Development projects of commercial and Turkish Defense Industry companies. Its supports to construction and development of TEMP (Thermochemical and Electrochemical Material Processing) laboratories are important contributions to METE.

TÜBİTAK 1003: Electronic Packaging of MEMS

Microelectromechanical systems (MEMS) are micron-size devices that can sense or manipulate the physical world. MEMS integrates microelectronic circuits and mechanical structures on the same chip. MEMS devices require good encapsulation in terms of mechanical protection, hermetic sealing and electrical connection. A research team consists of scientists from METE, METU-MEMS and ASELSAN will be working together in a TUBITAK 1003 project to develop new materials and procedures for electronic packaging to be used in critical MEMS applications. The project is supervised by Assoc Prof. Y. Eren Kalay.

MEMS are often used in Thermal Camera Airbag Systems Gyrosopes Microbolometers

Schematics of MEMS

Bonding made by thermal evaporation
SSAB SWEDISH STEEL SEMINAR SERIES

Björn Helgesen, Tomas Visur, Carl Chapman

«SSAB is a global leader in high strength steel.»

April 16th, 2014
For 3rd & 4th Grade Students—92 Students

Production and Metallurgy
Steels on Heavy Transport, Lifting, Automotive
Welding of High Strength Steel
Design Principles
Fatigue
Forming
Seda Oturak, senior METE student, landed her own exhibit of scanning electron microscopy micrographs in university library hall. Seda used false coloring technique to display the electron microscopy images in color. The exhibit includes several examples of electron microscopy studies from nanowires to copper smelting slags conducted by our graduate students. The exhibit attracted a great attentions of undergraduate and graduate students, university faculty and staff.

Examples of false-colored micrographs exhibited in the display. Left: CuO nanoflakes produced by a hydrothermal method, Right: CuO nanoflakes produced by a hydrothermal method.

2014 International Year of Crystallography

The year 2014 was declared the International Year of Crystallography by the United Nations in order to attract attention to crystals used in various engineering applications. We celebrated this important event by various activities. Prof. Matthew Kramer, Prof. Cevdet Noyan and Dr. Ercan Esen Alp gave speeches in our department. Dr. Y. Eren Kalay organized a “symmetry photo competition” between the junior students. Dr. Mert Efe conducted a “treasure-hunt crystallography” game for high-school kids.

Symmetry photo competition winner is Sahin Goren, METE Junior student. The photo was taken from Karaz Bridge in Erzurum. It contains mirror-like and 2-fold rotational symmetries.
OUTREACH

MATTER: The Very First Undergraduate Research Journal in Turkey

We are very pleased to present our first issue of the “MATTER”, a scientific journal in metallurgy and materials science dedicated to undergraduate students. Apparently, there are many scientific journals orientated for faculty and graduate students but not many for undergraduate students. We deeply hope that MATTER will be a robust platform of undergraduates conducting research in the field of metallurgy and materials science.

The first issue contains:
- Bilen Akuzum, "HYDROTHERMAL SYNTHESIS AND CHARACTERIZATION OF LiMnPO4 CATHODE MATERIALS"
- Seda Oturak, "FABRICATION OF NANOPOROUS Ni VIA DEALLOYING OF ZINC-NICKEL COATINGS"
- Ezgi Onur, "SPARK DISCHARGE SYNTHESIS OF IRON OXIDE NANOPARTICLES"
- Sakine Deniz Varsavas, "MICROSTRUCTURAL EVOLUTION OF A5083 ALLOY DURING FRICTION STIR WELDING"
- Mustafacan Kutsal, "PRODUCTION OF LEAD-FREE SOLDER POWDERS"

Journal can be reached at http://matter.mete.metu.edu.tr/

Young Metallurgists...

We have hosted several international and national high-school students throughout the year. Those students were welcomed by an introductory presentation of Metallurgy and Materials Science and they had been involved into several hands-on experiments in the such areas of shape-memory alloys, catalysis, electron microscopy, biomaterials, nanomaterials, mechanical strength etc.

High-school students from Londra St Joseph College (England) and Rouen Blaise Pascal Lycee (France).

Students preparing specimens for electron microscopy analyses.
IMMC 2014

The Chamber of Metallurgical Engineers of Turkey organized 17th International Metallurgy and Materials Congress (IMMC 2014) in Istanbul (11-13 September 2014). Starting from the first congress held in 1975, this traditional congress "IMMC" together with the trade fair is the largest event of Turkey in this field. This year conference was successfully chaired by our faculty member Prof. Macit Ozenbas. Prof. Caner Durucan, Assoc. Prof. Arcan Dericioglu and Assoc. Prof. Y. Eren Kalay served on the organizing committee. 166 research papers from 15 countries were presented during the meeting. Young researcher, poster and micrograph awards were given to successful entries.

IMMC’14 Organization Committee members.

TMS 2015 (Conference annually organized by The Minerals, Metals and Materials Society) was taken place in Orlando, FL, USA. METE participated in this meeting with 9 talks and 6 posters given by graduate students (Ayse Merve Genc, Simge Tulbez, Ezgi Butev, Mustafacan Kutsal, Doga Doganay, Ozgun Acar, Mert Ovun, Eyup Can Demir) and faculty members (Arcan Dericioglu, H. Emrah Unalan, Y. Eren Kalay, Mert Efe) of our department. Dr. Kalay and Dr. Unalan chaired “Phase Transformations and Microstructural Evolution — Crystallization and Diffusional Transformations” and “Nanostructured Materials for Rechargeable Batteries and for Supercapacitors” sessions, respectively. Poster co-authored by Dr. Kalay was awarded as the second place in “Poster Competition” sponsored by Materials Characterization Committee of TMS.

METE grad students Ozgun, Mustafacan, Doga, Eyup Can and Mert are taking the advantage of nice weather after the meeting.
OUTREACH

METE is on FACEBOOK!

METE is now officially on Facebook (https://tr-tr.facebook.com/metumetE)

We post recent news and latest updates regarding to our department. We gladly answer questions/comments of prospective undergrad/grad students in the matter of metallurgical and materials engineering.

HAPPY NEW YEAR!!

METE publishes a “Happy New Year!” video message on ‘Youtube’. This message is composed of collaged electron microscopy studies performed by the graduate students of METE working in various subjects from nanotechnology to casting. You can watch the video using the following link:

https://www.youtube.com/watch?v=gsr01rbZIQ&feature=youtu

‘Materials Matter’ will kick-off soon!

A new program which will allow the undergraduate students from all engineering departments to conduct materials science related research will kick-off soon. Please stay tune for the updates.

www.mete.metu.edu
Dr. Unalan received Prestigious TUBITAK Award

Our faculty member, Assoc.Prof. Emrah Unalan received the TUBITAK 2014 Incentive Award. The Incentive Award, which is presented to young scientists, currently living, who have proven they have the qualities to contribute significantly to science at an international level with their research, who are no older than 40 on the first day of the year in which the award is presented. Dr. Unalan's research group works on the solution-based, cheap and large-scale synthesis of nanomaterials in different chemistries. Following synthesis, they are fabricating devices utilizing these nanomaterials to explore their properties. Devices of interest include light emitting diodes, transistors, solar cells, batteries and supercapacitors.

Two Awards in “Metallic Ideas” Project Contest

Prof. Ali Kalkanlı's project entitled as “The Production of Powder Extruded Al-Fe-V-Si Alloys” was awarded as the first place in “entrepreneur category” of “2013-Metallic Ideas” project contest organized by Istanbul Ferrous and Non-Ferrous Metals Exporters’ Association. In the same contest, Assoc. Prof. Y. Eren Kalay was awarded as the second place in “academic category” with his project entitled as “Production of Al-RE(RE: Rare-earth element) amorphous/nanocrystalline composite materials”.

Our Grad Students Accomplishments...

Our grad students, Barış Alkan (MS), Bengi Yagmurlu (MS) and Halil İbrahim Yavuz (Ph.D.) received the “Young Researcher Award” in IMMC 2014 conference for the excellence in their thesis research. Mertcan Başkan, Serkan Yılmaz, Seda Oturak, Burak Aktekin and Ece Alpugan received “Micrograph Awards” in the same conference.

Our recent Ph.D. graduate, Metehan Erdogan, received the prestigious “2013-Parlar Foundation Thesis Award”. Sahin Coskun and Tuba Demirtas MS theses were awarded by METU Graduate School of Natural and Applied Science in 2013 and 2014, respectively. MS student Can Yıldırım received the best poster award in “2013 National Electron Microscopy Congress” held in Mersin.

Our grad students Ozlem Altintas Yıldırım and Mehmet Yıldırım won the “2015-Serhat Ozyar Honor Award” regarding to their highly-qualified Ph.D. works.
Cavit’s Success in TUBITAK Competition

Cavit Eyövge, senior METE students, has won the TUBITAK’s Capstone Design Project Competition with his project on metal hydride batteries. Normally metal hydride batteries makes use of AB\textsubscript{5} compounds with discharge capacity of around 380 mAh/g. Cavit Eyövge in his study made an attempt to replace AB\textsubscript{5} with Mg based compounds with a potential discharge capacity of three times that of AB\textsubscript{5}. The study concentrates on methods of encapsulating Mg based active material so as to prevent its corrosion in alkaline environment. We congratulate Cavit and his academic advisor Prof. Tayfur Ozturk.

BEST MICROGRAPHS AWARDS

Our undergraduate and graduate students received several awards regarding to electron micrographs.

Berke Oksuz: Winner, Best Electron Microscopy Photo, 21st Electron Microscopy Congress, Mersin, Turkey. (Upper left)
Sahin Coskun: Winner, Best Electron Microscopy Photo, UNAM, Bilkent University, Turkey. (Bottom Left)
MATERIALS SCIENCE AND ENGINEERING

The department of Metallurgical and Materials Engineering in METU was established in 1966. It currently holds 355 undergraduates and 104 masters and 37 Ph.D. students. In addition to core program, the department offers minor programs in metal production and ceramics.

The infrastructure of the department is well-established and it can respond the needs of the proposed research with the assistance of the service laboratories. In addition to the general service laboratories, each faculty member holds research laboratories specialized to their area of research. The primary research areas of focus in these laboratories are:

- Biomaterials
- Ceramic and Inorganic Materials
- Structural Materials
- Energy and Environment
- Metallurgy
- Computational Material Science
- Electronic-Magnetic Materials
MISSION STATEMENT

“The Department’s mission is to carry out educational programs to graduate high quality, nationally and internationally recognized engineers with strong backgrounds in materials related scientific and engineering problem-solving methods.”
UNDERGRADUATE PROGRAM

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.

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. In addition to its solid core program department offers various technical elective courses on various aspects such as nanomaterials, energy, biomaterials, extractive metallurgy, electrical, magnetic and optical properties of materials. Students take capstone design project in their senior year, by pursuing a real world engineering application.
GRADUATE PROGRAM

Graduate programs in METE are designed to present the students with systematic development of the fundamental scientific and engineering principles underlying materials phenomena and process operations. The Department offers 3 types of graduate programs:

• **M.S.**
• **Ph.D.**
• **Integrated Ph.D. Program**

Course Requirements: **M.S. students** are required to take a minimum of 7 courses apart from a Master's thesis. Program involves 3 compulsory courses, seminar and the remaining courses are restricted electives which are taken by the student in close cooperation with their advisors.

For the **Ph.D. Degree**, an additional 7 courses and a Ph.D. thesis should be successfully completed. In **integrated Ph.D program**, the students are required to take a minimum of 14 courses apart from a Ph.D. thesis.
# UNDERGRADUATE CURRICULUM

## FIRST YEAR

<table>
<thead>
<tr>
<th>First Semester</th>
<th>Second Semester</th>
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<tbody>
<tr>
<td>MATH 119</td>
<td>Calculus for Functions of Several Variables</td>
</tr>
<tr>
<td>PHYS 105</td>
<td>General Physics II</td>
</tr>
<tr>
<td>CHEM 111</td>
<td>General Chemistry II</td>
</tr>
<tr>
<td>ME 105</td>
<td>Introduction to Metallurgical and Materials Engineering</td>
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<tr>
<td>IS 100</td>
<td>English for Academic Purposes II</td>
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<tr>
<td>ENG 101</td>
<td>English for Academic Purposes II</td>
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## SECOND YEAR

<table>
<thead>
<tr>
<th>Third Semester</th>
<th>Fourth Semester</th>
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<tbody>
<tr>
<td>METE 201</td>
<td>Material Science II</td>
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<tr>
<td>METE 203</td>
<td>Thermodynamics of Materials II</td>
</tr>
<tr>
<td>MATH 219</td>
<td>Materials Laboratory</td>
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<tr>
<td>CENG 230</td>
<td>Chemical Principles of Material Production</td>
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<tr>
<td>ENG 211</td>
<td>Statics and Strength of Materials</td>
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<tr>
<td>METE 215</td>
<td>Restrictive Elective</td>
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## THIRD YEAR

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<tr>
<th>Fifth Semester</th>
<th>Sixth Semester</th>
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<tbody>
<tr>
<td>METE 301</td>
<td>Principles of Solidification</td>
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<tr>
<td>METE 303</td>
<td>Fundamentals of Mechanical Shaping</td>
</tr>
<tr>
<td>METE 305</td>
<td>Chemical Metallurgy I</td>
</tr>
<tr>
<td>METE 307</td>
<td>Physical Metallurgy</td>
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<td>METE 300</td>
<td>Material Characterization</td>
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<td>Restricted Elective</td>
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<td>Nontechnical Elective</td>
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## FOURTH YEAR

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<tr>
<th>Seventh Semester</th>
<th>Eighth Semester</th>
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<tbody>
<tr>
<td>METE 401</td>
<td>Materials Engineering Design II</td>
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<tr>
<td>METE 403</td>
<td>Technical Elective x 4</td>
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<tr>
<td>METE 407</td>
<td>Free Elective</td>
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<tr>
<td>METE 451</td>
<td>Ceramic Materials</td>
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<tr>
<td>METE 400</td>
<td>Technical Elective x 2</td>
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# UNDERGRADUATE CURRICULUM

## Elective Courses

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<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>METE 411</td>
<td>Chemical Metallurgy of Steel</td>
</tr>
<tr>
<td>METE 414</td>
<td>Steels and Steel Production Techniques</td>
</tr>
<tr>
<td>METE 416</td>
<td>Fuels and Furnaces</td>
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<tr>
<td>METE 417</td>
<td>Computer Application in Metallurgy</td>
</tr>
<tr>
<td>METE 418</td>
<td>Unit Operations and Pretreatment Process</td>
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<tr>
<td>METE 421</td>
<td>Glass Science and Technology</td>
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<tr>
<td>METE 422</td>
<td>Structural Ceramics and Ceramic Composites</td>
</tr>
<tr>
<td>METE 433</td>
<td>Materials for Organic Electronics</td>
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<tr>
<td>METE 434</td>
<td>Principles of Ceramic Processing</td>
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<tr>
<td>METE 435</td>
<td>Foundry Laboratory I</td>
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<td>METE 436</td>
<td>Foundry Laboratory II</td>
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<tr>
<td>METE 441</td>
<td>Melting and Casting</td>
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<tr>
<td>METE 443</td>
<td>Computer Modeling and Simulations in Materials Science and Engineering</td>
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<td>METE 444</td>
<td>Electronic and Magnetic Ceramics</td>
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<tr>
<td>METE 455</td>
<td>Elect. Mag. &amp; Optic Properties of Materials</td>
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<td>METE 456</td>
<td>Surface Properties of Materials</td>
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<td>METE 460</td>
<td>Engineering with Polymers</td>
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<td>METE 464</td>
<td>Heat Treatment of Metals</td>
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<td>METE 466</td>
<td>Powder Metallurgy</td>
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<td>METE 468</td>
<td>Welding Metallurgy</td>
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<td>METE 470</td>
<td>Composite Materials</td>
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<td>METE 472</td>
<td>Corrosion and Oxidation of Metals</td>
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<td>METE 474</td>
<td>Failure Analysis</td>
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<td>METE 477</td>
<td>Testing &amp; Evaluation of Materials</td>
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<td>METE 478</td>
<td>Nondestructive Evaluation of Materials</td>
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<td>METE 480</td>
<td>Electron Microscopy in Materials Science</td>
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<td>METE 487</td>
<td>Thin Films and Its Applications</td>
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<tr>
<td>METE 388/488</td>
<td>Materials Research I-II</td>
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# GRADUATE CURRICULUM

## M.S and Ph.D Courses

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<th>Course</th>
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<tr>
<td>METE 501</td>
<td>Thermodynamics of Materials</td>
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<tr>
<td>METE 503</td>
<td>Mathematical Methods in Materials Research I</td>
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<tr>
<td>METE 506</td>
<td>Kinetics of Processes in Materials</td>
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<td>METE 580/590</td>
<td>Prethesis Seminar /Seminar</td>
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<td>4 Elective Courses</td>
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## Elective Courses

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<th>Course</th>
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<tr>
<td>METE 504</td>
<td>Mathematical Methods in Materials Research II</td>
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<td>METE 505</td>
<td>Fracture</td>
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<td>METE 507</td>
<td>Advanced Crystallography and Diffraction</td>
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<td>METE 508</td>
<td>Advanced Optical Techniques</td>
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<tr>
<td>METE 509</td>
<td>Physics of Materials I</td>
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<tr>
<td>METE 510</td>
<td>Physics of Materials II</td>
</tr>
<tr>
<td>METE 511</td>
<td>Advanced Powder Metallurgy</td>
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<td>METE 512</td>
<td>Advanced Ceramic Engineering</td>
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<td>METE 515</td>
<td>Composite Materials</td>
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<td>METE 516</td>
<td>Production of Ferroalloys</td>
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<td>METE 517</td>
<td>Gas Metal Reaction</td>
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<td>METE 518</td>
<td>Physical Chemistry in Process Metallurgy</td>
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<td>METE 520</td>
<td>Process Analysis in Metallurgical Reaction Systems</td>
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<td>METE 521</td>
<td>Advanced Foundry Techniques</td>
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<td>METE 522</td>
<td>Bioceramics</td>
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<td>METE 525</td>
<td>Extractive Metallurgy of Copper</td>
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<tr>
<td>METE 527</td>
<td>Advanced Chemical Metallurgy</td>
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GRADUATE CURRICULUM

Elective Courses

METE 528  Computer Applications in Materials Science
METE 529  High Strength Alloys
METE 532  Selection of Materials Against Corrosion and Oxidation
METE 538  Advanced Solidification
METE 539  Near Net Shape Processing
METE 540  Phase Stability in Alloys
METE 544  Properties of Glass
METE 545  Atomistic Computer Modeling of Mat.
METE 546  Nanostructured Materials
METE 550  Solar Cells
METE 555  Processing and Properties of Nanocomposites
METE 560  Polymer Nanocomposites
METE 565  Structure of Materials
METE 580  Prethesis Seminar
METE 590  Seminar
METE 600  Ph.D. Thesis
ANKARA Alpay  
Ph.D. Imperial College

ATALA Haluk  
Ph.D. University of Birmingham

DORUK Mustafa  
Ph.D. Tech. Hochschule Darmstadt

GEVECİ Ahmet  
Ph.D. METU

SELÇUK Ekrem  
Ph.D. University of Sheffield

SEVİNÇ Naci  
Ph.D. M.I.T.

OĞURTANI Tarık Ömer  
Ph.D. Stanford University

ТИМУÇИН Muharrem  
Ph.D. University of Missouri Rolla

TOPKAYA Yavuz  
Ph.D. McMaster University
Research Associates
TAN, Cengiz Mehmet
YILMAZ, Serkan

Staff
AÇİŞ, İshak
CEYLAN, Hüseyin
ESKİYAZICI, Hamdiye
GÖL, Ayhan
HAZIR, Hüseyin
ÖZEL, Nilüfer
ÖZDEMİR, Arif Atalay
ÖZDEMİR ARSLAN, Ebru
PULLU, Nimet
ŞAHİN, Önder
SITKI, Levent
TÜRE, Salih
YANARDAĞ, Cemal
YAPICI, Erdoğan
YAZICI, Gül
YILDIRIM, Yusuf
Faculty Members

AKDENİZ Vedat: Ph.D. Open University
AYDINOL Mehmet Kadri: Ph.D. METU
BOR Şakir: Ph.D. METU
DERİÇİOĞLU Arcan Fehmi: Ph.D. Tokyo University
EFE, Mert: Ph.D. Purdue University
GÜR, Cemil Hakan: Ph.D. METU
GÜRBÜZ Rıza: Ph.D. METU
İMER Bilge: Ph.D. University of California Santa Barbara
KALAY Yunus Eren: Ph.D. Iowa State University
KALKANLI Ali: Ph.D. Open University
KARAKAYA İshak: Ph.D. McGill University
KAYNAK Cevdet: Ph.D. METU
MEKHRABOV Amdulla.: Ph.D. Lom. Moscow State Uni.
ÖGEL Bilgehan: Ph.D. METU
ÖZENBAŞ Macit: Ph.D. METU
ÖZTÜRK Abdullah: Ph.D. University of Missouri Rolla
ÖZTÜRK Tayfur: Ph.D. Cambridge University
ÜNALAN Hüsnü Emrah: Ph.D. Rutgers University
YENER Kuru: Ph.D. Max Planck Institute
M. Vedat Akdeniz

Ph.D.: The Open University, UK (1989)
M.S.: Middle East Technical University, Turkey
B.S.: Middle East Technical University, Turkey

Research Interest

Bulk Amorphous/Nanocrystalline Alloys, Metallic Glasses Alloy Design and Development, Advanced Magnetic Materials, Intermetallics, Rapid Solidification

Selected Publications


Novel Alloys Design and Development Laboratory (NOVALAB)
mete.metu.edu.tr/labs/novel-alloys-design-and-development-laboratory
Mehmet Kadri Aydinol

Research Experiences: Massachusetts Institute of Technology, USA
Ph.D.: Middle East Technical University, Turkey (1994)
M.S.: Middle East Technical University, Turkey
B.S.: Middle East Technical University, Turkey

Research Interest
Atomistic Computer Modeling of Materials: ab-initio Methods, Monte Carlo and Molecular Dynamics Simulations.


Selected Publications

Professor
Department of Metallurgical and Materials Engineering
D-103
Middle East Technical University

Phone: +90 (312) 210 2523
E-mail: kadri@metu.edu.tr

Energy Storage Devices and Battery Laboratory
mete.metu.edu.tr/labs/energy-storage-devices-and-battery-laboratory
Şakir Bor

Ph.D.: Middle East Technical University, Turkey (1981)
M.S.: Middle East Technical University, Turkey
B.S.: Middle East Technical University, Turkey

Research Interest
Solid State Phase Transformations
Transmission Electron Microscopy
Shape Memory Alloys
Titanium Foams Produced by Powder Metallurgy

Selected Publications
Arcan F. Dericioğlu

Research Experiences: National Institute for Materials Science, Tsukuba, Japan
Institute of Industrial Science, Tokyo, Japan
Ph.D.: The University of Tokyo, Japan (2002)
M.S.: Middle East Technical University, Turkey
B.S.: Middle East Technical University, Turkey

Research Interest

Selected Publications

Electromagnetic Materials Laboratory
mete.metu.edu.tr/labs/electromagnetic-materials-laboratory

Associate Professor
(Vice Chair)
Department of Metallurgical and Materials Engineering
D-106
Middle East Technical University
Phone: +90 (312) 210 5941
E-mail: arcan@metu.edu.tr
Caner Durucan

Research Experiences: Pennsylvania State University, USA
M.S.: Pennsylvania State University, USA
B.S.: Middle East Technical University, Turkey

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

Selected Publications

Professor
(Vice Chair)
Department of Metallurgical and Materials Engineering
D-306
Middle East Technical University

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E-mail: cdurucan@metu.edu.tr

Materials Chemistry Laboratory
mete.metu.edu.tr/labs/materials-chemistry-laboratory
Mert Efe

Research Experiences: Purdue University & Convolutus Inc.
Ph.D.: Purdue University, West Lafayette, IN, USA (2012)
M.S.: Purdue University, West Lafayette, IN, USA (2008)
B.S.: Middle East Technical University, Turkey (2005)

Research Interest

Selected Publications

Assistant Professor
Department of Metallurgical and Materials Engineering
D-104
Middle East Technical University
Phone: +90 (312) 210 5925
E-mail: mefe@metu.edu.tr
C. Hakan Gür

Research Experiences: Lab. of X-Ray Diffraction and Microanalysis in Physical Metallurgy, BAM-Berlin, Gemany

Ph.D.: Middle East Technical University, Turkey (1995)
M.S.: Middle East Technical University, Turkey
B.S.: Middle East Technical University, Turkey

Research Interest
Nondestructive Testing and Materials Characterization; Welding;
Determination of Residual Stresses; Heat Treatment of Steels;
Computer Simulation of Heat Treatment & Welding

Selected Publications
Rıza Gürbüz

Ph.D.: Middle East Technical University, Turkey (1987)
M.S.: Middle East Technical University, Turkey
B.S.: Middle East Technical University, Turkey

Research Interest
Failure Analyses, Fatigue Crack Growth, Fracture and Fatigue Behavior of Railway Rails and Wheels, Mechanical Testing

Selected Publications

Professor
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D-206
Middle East Technical University

Phone: +90 (312) 210 5933
E-mail: rgurbuz@metu.edu.tr

Failure Analyses Laboratory
metu.edu.tr/~rgurbuz
Bilge İmer

Research Experiences: UCSB, USA, Bilkent-UNAM, ASELSAN
Ph.D.: University of California Santa Barbara, CA, USA. (2006)
M.S.: University of California Santa Barbara, CA, USA.
B.S.: University of Pittsburgh, PA – USA (Transferred from Middle East Technical University, Turkey.

Research Interest

Thin film material (functional coatings, device structure) growth; Bulk crystal growth; Device and nano-structured materials processing, simulation and testing

Patents

1. 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)", Bilge İmer, James S. Speck, Steven P. DenBaars
2. U.S. patent # 20060270087 “Growth of non-polar (1-100) m-plane GaN with Metalorganic Chemical Vapor Deposition (MOCVD)”, Bilge İmer, Shuji Nakamura, James S. Speck, Steven P. DenBaars

Selected Publications

Yunus Eren Kalay

**Research Experiences:** Ames Laboratory US DOE, USA
Argonne National Laboratory US DOE, USA

**Ph.D.:** Iowa State University, USA (2009)

**M.S.:** Middle East Technical University, Turkey

**B.S.:** Middle East Technical University, Turkey

**Research Interest**
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**

Metals Development Laboratory
http://labs.mete.metu.edu.tr/sdml

Associate Professor
Department of Metallurgical and Materials Engineering
D-205
Middle East Technical University

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Ali Kalkanlı

Research Experiences: The University of Nottingham, UK
M.S.: Middle East Technical University, Turkey
B.S.: Middle East Technical University, Turkey

Professor
Department of Metallurgical and Materials Engineering
A-202
Middle East Technical University

Phone: +90 (312) 210 5929
E-mail: kalkanli@metu.edu.tr

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

Selected Publications
1. A. Changizi, A. Kalkanlı, N. Sevînc., Production of in situ aluminum–titanium diboride master
alloy formed by slag–metal reaction, Journal of Alloys and Compounds, Volume 509, Issue 2, 12,
2. A. Çetin, A. Kalkanlı, Numerical simulation of solidification kinetics in A356/SiCp composites
for assessment of as-cast particle distribution, Journal of Materials Processing Technology, Vol-
3. A. Çetin, A. Kalkanlı, Effect of solidification rate on spatial distribution of SiC particles in

Foundary, Metals Process & Automotive Materials Laboratory
mete.metu.edu.tr/labs/foundry-metal-processing-and-automotive-materials-laboratory
İshak Karakaya

Research Experiences: McGill University, Montreal, Canada
Royal Military College, Kingston, Canada
Ph.D.: McGill University, Canada (1985)
M.Eng.: McGill University, Canada
B.S.: Middle East Technical University, Turkey

Research Interest
Thermochemistry of molten oxide and molten salt systems, Molten salt and aquous electrometallurgy, High temperature corrosion, Computational thermodynamics

Selected Publications
6. İ. Karakaya, M. Erdoğan, M., RU 2 463 387 C2 Production of tungsten and tungsten alloys from tungsten bearing compounds by electrochemical methods, Patent Letter Registration date: 2012/10/10, Russian Agency for Patents and Trademarks.

TEMP Thermochemical and Electrochemical Material Processing Laboratory
mete.metu.edu.tr/labs/thermochemical-and-electrochemical-materials-processing-laboratory
Cevdet Kaynak

Research Experiences: Imperial College London, University of Cambridge, England

Ph.D.: Middle East Technical University, Turkey (1994)

M.S.: Middle East Technical University, Turkey

B.S.: Middle East Technical University, Turkey

Research Interest

Development of Polymer Based Nanocomposites for Engineering Applications

Selected Publications


**Yener Kuru**

**Research Experiences:** Max Planck Institute for Solid State Research, Germany, MIT, USA

**Ph.D.:** Max Planck Institute for Metals Research and Stuttgart University, Germany (2008)

**M.S.:** Sabanci University, Turkey

**B.S.:** Middle East Technical University, Turkey

**Research Interest**

Size-Dependent Properties in Metals and Oxides; In Situ X-Ray Diffraction; Residual Stress and Texture Analysis in Thin Films; Chemical Expansion in Complex Oxides; Novel Properties at Interfaces

**Selected Publications**


**Associate Professor**

Department of Metallurgical and Materials Engineering  
E-212  
Middle East Technical University

Phone: +90 (312) 210 5911  
E-mail: ykuru@metu.edu.tr
Amdulla O. Mekhrabov

**Research Experiences:** Lomonosov Moscow State University, USSR
Tokyo University, Japan
University of California, USA

**Dr.Sc.:** Tbilisi State University, Georgia (1989)

**Ph.D.:** Lomonosov Moscow State University, USSR (1978)

**B.S.:** Azerbaijan State University, Azerbaijan

**Research Interest**
Alloy-Design; Metal&Alloy Physics; Computational Materials Science; Intermetallics;
Atomic/Magnetic Ordering; Bulk Amorphous/Nanocrystalline Materials;
Metal-Hydrides&Hydrogen Storage Materials; Magnetic & Magnetocaloric Materials; Nanoalloys

**Selected Publications**
Bilgehan Ögel

Ph.D.: Middle East Technical University, Turkey (1990)
M.S.: Middle East Technical University, Turkey
B.S.: Middle East Technical University, Turkey

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

Professor
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Middle East Technical University

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E-mail: bogel@metu.edu.tr

Selected Publications
A. Macit Özenbaş

Research Experiences: Materials Research Institute, Princeton University, NJ, USA
Max Planck Institute for Metal Research, Stuttgart, Germany

Ph.D.: Middle East Technical University, Turkey (1981)
M.S.: Middle East Technical University, Turkey
B.S.: Middle East Technical University, Turkey

Research Interest
Mesoscopic solar cells for renewable energy applications,
Magnetic nanoparticles for enhanced MRI,
Lead-free piezoelectric/ferroelectric thin films, Oxide
thermoelectric materials for power conversion

Selected Publications


Surface Sciences Research Laboratory
mete.metu.edu.tr/labs/surface-science-research-laboratory
Abdullah Öztürk

Ph.D.: University of Missouri Rolla, USA (1991)
M.S.: University of Missouri Rolla, USA
B.S.: Istanbul Technical University, Turkey

Research Interest
Production, Properties, and Characterization of Ceramic Materials, Glasses and Glass Ceramics, Cements, Ceramic Matrix Composites, Biomaterials, Dental Materials, Tribology, Cements, Photocatalytic materials

Selected Publications

Professor
Department of Metallurgical and Materials Engineering
E-120
Middle East Technical University

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E-mail: abdullah@metu.edu.tr

Glass Science and Technology Laboratory
mete.metu.edu.tr/labs/photocatalytic-materials-laboratory
Tayfur Öztürk

Ph.D.: Cambridge University, UK (1978)
B.S.: Istanbul Technical University, Turkey

Research Interest
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
Hüsnü Emrah Ünalan

Research Experiences: University of Cambridge, UK
Ph.D.: Rutgers University, USA (2006)
B.S.: Middle East Technical University, Turkey

Research Interest

Transparent, Flexible and Stretchable Electronics
Nanowires and Carbon Nanotubes
Solar cells, Light Emitting Diodes, Supercapacitors, Batteries and Photo-detectors

Selected Publications


Associate Professor

Department of Metallurgical and Materials Engineering
D-203
Middle East Technical University

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E-mail: unalan@metu.edu.tr

Nanomaterials and Devices Laboratory
mete.metu.edu.tr/labs/nanomaterials-and-devices-laboratory
RESEARCH AREAS

Metallurgy

Energy and Environment

Computational Material Science

Structural Materials

Electronic and Magnetic Materials

Ceramic and Inorganic Materials

Biomaterials

Polymers & Nanocomposites
The research on metallurgy is one of the cornerstones of the departmental scientific point of view. The main studies on this area includes: heat treatment of steels, brazing, compact and spheroidal graphite cast irons, squeeze casting, pressure die casting, thixocasting, alloy powder extrusion for high temperature, thermochemistry of molten oxide and molten salt systems, molten salt and aqueous electrometallurgy, iron-steel making, extractive metallurgy, hydrometallurgy, pyrometallurgy, pretreatment processes and mineral processing, waste treatment and utilization.

**Laboratories for specialized research in this area:**
- Foundry, Metal Process. & Automotive Materials Laboratory
- Hydrometallurgy Laboratory
- Pyrometallurgy Laboratory
- Thermochemical and Electrochemical Material Processing Laboratory

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**Electronic & Magnetic Materials**

The research activities on electronic and magnetic materials is rapidly growing in the department. Studies on electronic and magnetic materials cover: sensors, piezoelectric devices, ceramic semiconductors, magnetic and magnetocaloric materials, lead-free piezoelectric and ferroelectric thin films, oxide thermoelectric materials for power conversion magnetic properties of nanostructured materials for enhanced MRI, large area, transparent and flexible electronics, solar cells, light emitting diodes, electronic packaging.

**Laboratories for specialized research in this area:**
- Electromagnetic Materials Laboratory
- Nanomaterials and Devices Laboratory
- Novel Alloys Laboratory
- Surface Sciences Research Laboratory
- Metals Development Laboratory

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**Energy & Environment**

The pursuit for alternative energy resources has been lately become an international concern. The department of METE does not stay disregardful for this subject and it focuses on the following area of research: advanced magnetic materials, lithium-ion, Ni-MH, lead-acid and silver-zinc batteries, hydrogen storage alloys and compounds, electrochemistry of materials, lead-free materials, dye sensitized solar cells for renewable energy applications, conductive electrode surface preparation for DSSCs and supercapacitors.

**Laboratories for specialized research in this area:**
- Energy Storage Devices Laboratory
- Energy Storage Materials Laboratory
- Nanomaterials and Devices Laboratory
- Novel Alloys Laboratory
- Surface Sciences Research Laboratory
- Thermochemical and Electrochemical Material Processing Lab.
CERAMIC & INORGANIC MATERIALS

The department has extensive research capability in ceramic processing and characterization. This covers both traditional and modern ceramics. Examples of the ongoing projects are: production, properties and characterization of ceramic materials, glasses and glass ceramics, cements, ceramic matrix composites, tribology, cements, bioceramics, calcium phosphates, glass surfaces, interfaces and coatings and sol-gel chemistry (silicates, organic-inorganic hybrid systems).

**Laboratories for specialized research in this area:**
- Ceramic Engineering Laboratory
- Materials Chemistry Laboratory
- Glass Science and Technology Laboratory

COMPUTATIONAL MATERIALS SCIENCE

Computational material science has become a major tool in most areas of material research. Activities in the department in this area include a variety of topics such as: void growth in integrated circuits under electromigration condition, phase stability of intermetallic alloys; ab-initio molecular dynamics, reverse Monte-Carlo simulations, finite element methods, computer simulation of heat treatment & welding, computational thermodynamics, thermal analysis and casting simulations.

**Laboratories for specialized research in this area:**
- Computer Simulation Laboratory
- Energy Storage Devices Laboratory
- Foundry, Metal Pro. & Automotive Materials Laboratory
- Novel Alloys Laboratory
- Metals Development Laboratory
- Thermodynamic Studies Laboratory

BIOMATERIALS

Research in bio/organic materials covers synthesis and processing of bioactive ceramics, hydroxyapatite and a variety of bioglass formulations. The development of bioactive coatings and surfaces to interact with biomolecules such as bacteria, proteins, DNA are also in progress. Current projects involve Ti-foams, the development of coatings doped with metallic nanoparticles for a variety of functions; e.g. magnetic or antibacterial, bioceramics and dental materials.

**Laboratories for specialized research in this area:**
- Ceramic Engineering Laboratory
- Photocatalytic Materials Laboratory
STRUCTURAL MATERIALS

Studies on structural materials usually refers to the microstructure-mechanical property relationship from nano to macro length scales. Examples of researches conducted at METE can be stated as: bulk amorphous/nanocrystalline alloys, solid state phase transformations, nano-multilayer composites, NDT, residual stresses; heat treatment of steels; failure analyses, fatigue crack growth, fracture and fatigue behavior of railway rails and wheels, aluminum matrix composites and ceramic matrix composites.

Laboratories for specialized research in this area of study:
Foundry, Metal Pro. & Automotive Materials Laboratory
Electromagnetic Materials Laboratory
Metals Development Laboratory
Mechanical Testing Laboratory
Novel Alloys Laboratory

POLYMER & NANOCOMPOSITES

Attributed primarily to their extraordinary properties, polymers constitute an important part of the research in the department. Examples of conducted studies are: development of polymer based nanocomposites for engineering applications, bio-inspired composites, biomedical materials and large area, transparent and flexible electronics.

Laboratories for specialized research in this area:
Materials Chemistry Laboratory
Nanomaterials and Devices Laboratory
Polymers and Nanocomposites Laboratory

“56”
Number of international papers published in 2013
Research Laboratories

Electromagnetic Materials Laboratory
Energy Storage Devices and Battery Laboratory
Energy Storage Materials Laboratory
Foundry, Metal Processing and Automotive Materials Laboratory
Glass Science and Technology Laboratory
Hydrometallurgy Laboratory
Mechanical Testing Laboratory
Metallography and Heat Treatment Laboratory
Metals Development Laboratory
Microscopy & X-ray Analysis Laboratory
Nanomaterials and Devices Laboratory
Novel Alloys Design and Development Laboratory
Photocatalytic Materials Laboratory
Polymers and Nanocomposites Laboratory
Pyrometallurgy Laboratory
Shape Memory Alloys and Ti Alloy Foams Laboratory
Surface Science Research Laboratory
Thermochemical & Electrochemical Material Processing Laboratory
Turbine and High Temperature Materials Technology Laboratory
Thermal Analysis Laboratory
Welding Technology and Non-Destructive Testing Center
Electromagnetic Materials Laboratory

Primary Researcher(s) / Coordinator(s):
Assoc. Prof. Dr. Arcan Dericioğlu

General Information:
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.

Equipment:
High Temperature Sintering Furnaces
Microwave Sintering Furnace
Dry Heat Sterilizer
Vacuum Drying Oven
Conventional Hot Press
Cold Isostatic Press
Ball Mill
Tape Caster
Planetary centrifugal homogenizing mixer
High shear mixer
Titration system
Vector Network Analyzer
Free Space Measurement Setup
Energy Storage Devices and Battery Laboratory

Primary Researcher(s) / Coordinator(s):
Prof. Dr. Kadri Aydınol

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

Equipment:
Hettich Centrifuge
Retsch PM400 Planetary Ball Mill
MBraun Unistar Glove Box
Retsch RM200
Retsch PM200
Carbolite Chamber Furnaces
Carbolite Split Furnaces
Carbolite Bottom Loading Furnace
Memmert Vacuum Drying Oven with Pump Module
Memmert Humidity Chamber
Freeze Dryer
Berghoff High Preactor
Indutherm Mini Casting Unit
Solartron Multistat
Princeton VersaStat
Primary Researcher(s) / Coordinator(s):
Prof. Dr. Tayfur Öztürk

General Information:
ESM laboratory 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. The research group is primarily dealt 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.

Equipment:
Vacuum/pressure (up to 10 bar) induction melting system
Ball mills (SPEX and Fritsch planetary ball mill)
Glove Box (MBraun Unistar)
Magnetron Sputtering System (with 3-sputtering and 3-thermal evaporation source Nanovak)
Induction plasma system with nanopowder reactor (Tekna)
Spark discharge generator (Palas GFG-1000)
Sievert’s PCT instrument
Gas Permeability Tester
Potentiostat/Galvanostat (Amatek)
Foundry, Metal Processing and Automotive Materials Laboratory

Primary Researcher(s) / Coordinator(s):
Prof. Dr. Ali Kalkanlı

General Information:
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, defense and machine industry. The research students are sponsored by government research funds such as TUBİTAK and State Planning Organization DPT, matching funds San-Tez Projects.

Equipment:
25 (İndemak) and 100 Kg (İnductotherm steel capacity induction furnace 15 Kg steel capacity vacuum induction melting (Elphiac Balzers)
18 Kg steel capacity Motor generator Magnethermic induction furnace
200 Tons capacity pressure die caster
15 Tons capacity thixocaster
Centrifugal casting machine
100 Tons/ 70 Tons Vertical hydraulic double action press multiple purpose for squeeze casting hot forming and powder pressing.
300 Kg aluminum melting resistance furnace
Sand muller
20 Kg aluminum capacity fuel fired furnaces for non ferrous alloys Forced convection tempering furnace (600 °C max temp)
Atmosphere controlled Heat treatment furnace with (Cracked ammonia atmosphere -1200 °C max temp)
Optical emission spectrometer WAS Foundrymaster
Glass Science and Technology Laboratory

Primary Researcher(s) / Coordinator(s):
Prof. Dr. Abdullah Öztürk

General Information:
The group is focused on the production of novel glasses, their characteristics and properties. The studies include glasses for self cleaning applications, Apatite-Wollastonite glass and glass ceramics, and glass ceramics to be used in dental applications.

Equipment:
Glass melting and crystalization furnaces
Centrifugal Separator
Pin-on-disk type Tribometer
Grinding and polishing equipments
Various other tools
Hydrometallurgy Laboratory

Primary Researcher(s) / Coordinator(s):
Prof. Dr. Yavuz Topkaya

General Information:
The research group is mainly focused on the mineral processing and hydrometallurgical extraction of various metals from their ores. In addition to metal extraction processes, purification of resultant leach solutions and recovery of the valuable metals from these solutions are among the research studies. Throughout these studies, the optimum process parameters for the maximum metal recoveries are mainly determined for industrial applications.

Equipment:
2 liter Parr Titanium Autoclave
Column and Agitative Leaching Systems
Jaw and Roll Crushers, Ball and Disc Mills
Pulverizer, Jig, Shaking Table
Magnetic Separator
Flotation Units
Vacuum Pumps and Filtration Units
Analytical Balances (various capacity), Sieve Analysis Set-up, Microscopes,
Drying Ovens
Various Muffle and Tube Furnaces,
Hot Plates with Contact Thermometers, and pH Meters
Solvent Extraction Unit
Materials Chemistry Laboratory

Primary Researcher(s) / Coordinator(s):
Prof. Dr. Caner Durucan

General Information:
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, organic/inorganic materials.

Equipment:
FTIR Spectrometer (Perkin Elmer Frontier, equipped with PIKE GladiATR Reflection, PIKE 80Spec, Specular Reflectance tools)
UV-Vis Spectrometer (Varian Cary 100 Bio)
Isothermal Titration Calorimeter (TAM Air, 8 Channel Calorimeter and TAM Air Thermostat)
Viscometer (Brookfield DV-E)
Coating equipment (Laurell WS-400B-6NPP-LITE spin coater, Bungard RDC15 dip coater)
General Laboratory equipment/appliances: A wet laboratory suitable for use of organic precursors, with water purification systems (DI-water), equipped with hot plates, mixers, drying ovens, furnaces, ambient and atmosphere controlled box and tube furnaces, ultrasonic baths, homogenizators, pH meters, centrifuges
Mechanical Testing Laboratory

Primary Researcher(s) / Coordinator(s):
Prof. Dr. Rıza Gürbüz

General Information:
This laboratory is served to undergraduate, graduate students and the faculty for teaching and research practices.

Equipment:
INSTRON 5582 Universal Testing Machine, 10 ton capacity, high-temperature furnace attachment, optical strain analysis
INSTRON 5565A Universal Testing Machine, 0.5 ton capacity, miniature scale testing ability, optical strain analysis. Suitable for testing thin sheets, composites, polymers and ceramics. Various load cells and load indicators.
10 ton MTS Universal Testing System for testing under controlled load, deflection or strain for fatigue, creep and stress relaxation studies.
60 ton capacity ALŞA hydraulic tension-compression-bending testing machine.
25 ton Dartec Universal Dynamic Testing Machine for tension, compression, bending and fatigue tests.
Crack monitoring systems for fracture toughness and fatigue crack kinetics tests.
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.
Metallography and Heat Treatment Laboratory

**Primary Researcher(s) / Coordinator(s):**
Assoc. Prof. Dr. Arcan Dericioğlu

**General Information:**
General metallography practices and heat treatment processes.

**Equipment:**
- Knoop Microhardness Tester
- Mechanical and Electrolytic Polishers
- Macro and Micro Etching Machines
- Cutters
- Automated Grain Size, Aspect Ratio, Volume Fraction, Nodule Count and Graphite Size Distribution with Clemex Image Analysis System
- Muffle and Tube Furnaces (operate under vacuum and atmosphere)
- Salt Baths
Primary Researcher(s) / Coordinator(s):
Assoc. Prof. Dr. Eren Kalay

General Information:
The research 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.

Equipment:
SPEX 8000M high-energy mechanical milling
Laboratory Size CNC instrument
3D Printer (Makerbot)
Indutherm Induction Melting Unit
Thermal-shock Instrument (-35 °C – +250 °C)
Quartz/Pyrex sealing system
Various other tools (high precision balance, high/low temperature furnaces, specimen preparation tools)
Microscopy & X-ray Analysis Laboratory

Primary Researcher(s) / Coordinator(s):
Assoc. Prof. Dr. Eren Kalay

General Information:
Scanning electron microscopy, energy dispersive spectroscopy, scanning/transmission electron microscopy, X-ray fluorescence, X-ray diffraction and various specimen preparation techniques.

Equipment:
Jeol JEM-2100F UHR/HRP Transmission Electron Microscope (200 kV)
FEI 430 Nano Scanning Electron Microscope (30 kV)
Jeol 6400 Scanning Electron Microscope (40 kV)
Bruker S8 TIGER X-Ray Fluorescence Analyzer
Rigaku DMAX 2200 X-Ray Diffractometer (3 kW rated output)
Fishione Electro polish
Fischione Ion Mill
Fischione Plasma Cleaner
Gold/Carbon Coater
Dimpling Grinder
Nanomaterials and Devices Laboratory

Primary Researcher(s) / Coordinator(s):
Assoc Prof. Dr. H. Emrah Ünalan

General Information:
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.

Equipment:
2-inch AIXTRON-Nano instruments, Plasma Enhanced Chemical Vapor Deposition (PECVD) system
3-source physical vapor deposition (PVD) system
MBraun Unistar Glove Box
Computer controlled 1-inch CVD system
Spectrometer/photometer/Integrated sphere
Light sources/UV lamps
Sourcemeters/picoammeter
Gamry 3000 Galvanostat/potentiostat
Makerbot 3D printer
Stretching and flexing device
Various other materials chemistry tools (spin coaters, tip/bath sonicators, dip/spray/ultrasonic spray coaters, ultrapure DI water generator, pH meters, vacuum furnace, high/low temperature furnaces)
Novel Alloys Design and Development Laboratory

Primary Researcher(s) / Coordinator(s):
Prof. Dr. Amdulla Mekhrabov & Prof. Dr. Vedat Akdeniz

General Information:
In brief, the research group is highly 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 metallic alloys.

The computational tools involve several workstations with first-principle calculation softwares such as abinito and Medea-Vasp, Molecular Dynamics and Monte Carlo packages and in-house electronic calculation, simulation and data analyses algorithms. The research group has a solid background in theoretical investigations of order-disorder and related phenomena in binary and ternary alloy systems.

Equipment:
Edmund Bühler Arc-Melting and Suction Casting Equipment.
Centrifugal Casting Equipment
Setaram Setsys Differential Scanning Calorimeter (DSC)
ADE Magnetics EV/9 model Vibrating Sample Calorimeter (VSM)
Fritsch Pulveristte 7 Planetary Ball Mill
Muffle and Elevator Furnaces
Various other tools (incubator, centrifugation, ultrasonic cleaning, magnetic stirrer, balances, grinding and polishing discs)
Photocatalytic Materials Laboratory

Primary Researcher(s) / Coordinator(s):
Prof. Dr. Abdullah Öztürk

General Information:
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.

Equipment:
Retsch PM100 Planetary Ball Mill
Hanil Fleta 5 Centrifugal Separator
Scinco S-3100 Spectrophotometer
UTO Instruments Autoclave
CSM Instruments Pin-on-disk type Tribometer
Light sources/UV lamps
Spin coater
High/low temperature furnaces,
Ultrasonic probe
Ultrasonic cleaner
Polymers and Nanocomposites Laboratory

Primary Researcher(s) / Coordinator(s):
Prof. Dr. Cevdet Kaynak

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

Equipment:
- Laboratory scale Twin-Screw Extruder for compounding
- Laboratory scale Injection Molding device for shaping
- Laboratory scale Compression Molding device for shaping
- Ball Milling and Screening system
- Polymer Pelletizer and Grinder
- MFI Melt Flow Index device
- Shore A and D Hardness tester
- QUV Accelerated Weathering Tester
- FTIR and UV-vis Spectrometers and DRA Diffuse Reflectance Color Analyzer
- Mechanical, magnetic and ultrasonic mixers, ultrasonic homogenizer
- Vacuum ovens for drying, and various high/low temperature furnaces
- Various precision balances
- Water purification system
Pyrometallurgy Laboratory

**Primary Researcher(s) / Coordinator(s):**
Prof. Dr. Ahmet Geveci

**Equipment:**
- Vertical Tube Furnace (max. 1700 °C)
- Horizontal Tube Furnace (max. 1700 °C)
- Muffle Furnace (1500 °C)
- Muffle Furnace (1100 °C)
- Analytical Balance (max. 850 g)
- Oxygen Prob (Oxygen Analyzer) (0.21 – 10⁻²⁰ atm.)
Shape Memory Alloys and Ti Alloy Foams Laboratory

Primary Researcher(s) / Coordinator(s):
Prof. Dr. Şakir Bor

General Information:
The group is focused on the production, processing and investigation of the relationship between mechanical properties and microstructure of shape memory alloys and porous titanium alloys for biomedical applications.

Equipment:
Rolling Mill: Flli Cavallin M.2200 Plate-Thread Rolling Mill, 15 mm to 0.1 mm thickness
Hydronic Press: 30 tons
Melting and Casting Unit: Linn,
High Frequency Melting & Casting Unit,
Vacutherm-3.3-Titan Atmosphere controlled tube furnaces for heat treatment and sintering
Solid Mechanics and Metal Forming Laboratory

Primary Researcher(s) / Coordinator(s):
Assist. Prof. Dr. Mert Efe

General Information:
Our main goal is to understand solid mechanics and forming behavior of metals under complex loading paths at a microstructural level. We observe the in-situ formation and evolution of defects during deformation processing by means high-resolution optical microscopy and digital image correlation techniques.

Equipment:

ERICHSEN 142/20 Cupping Machine

SHIMADZU AGS-J 10 kN Autograph

UTEST Biaxial Tensile Testing Apparatus

BASLER piA2400-17gm GigE camera with the Sony ICX625 CCD sensor

NAVITAR UltraZoom 6000 Optical Imaging systems with ZEISS Objectives

BOSCH PBD 40 710W Bench Drill

DREMEL 3000 Variable Speed Rotary Surface Finish and Polishing Tool
Surface Science Research Laboratory

Primary Researcher(s) / Coordinator(s):
Prof. Dr. Macit Özenbaş

General Information:
In Surface Science Research Laboratory (SSRL), the research is concentrated 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.

Equipment:
Computer controlled ferroelectric tester (Radiant), mercury probe
Controlled atmosphere tube furnace (Alser)
Keithley 740 scanning thermometer, Keithley 238 high current source, Keithley 182 sensitive digital voltmeter, LakeShore 336 temperature control unit, 4 point measurement system
Various other materials chemistry tools (spin coaters, tip/bath sonicators, ultrasonic spray coaters, ultrapure DI water generator, rotary evaporator)
Microwave oven (Milestone Roto-Synth)
High pressure reactor (Amar Equipments lab.)
4 zone belt furnace (Dyesol).
Lamination unit (Dyesol), substrate cleaning system (Dyesol)
3-ball mill (Fritsch), 3 roll mill (Exakt)
Sputtering unit (Baltec)
Thermal Analysis Laboratory

Primary Researcher(s) / Coordinator(s):
Prof. Dr. Vedat Akdeniz & Prof. Dr. Cevdet Kaynak

General Information:
Thermal analysis practices.

Equipment:
Setaram Differential Scanning Calorimetry (DSC) 131 Thermal Analyzer (operate between -170°C and 600°C)
Setaram SETSYS TG-DTA/DSC Thermal Analyzer (for simultaneous TG and DTA/DSC measurements, operate up to 1650°C)
Neutromag Digital Centrifugal Casting Machine (operate under controlled atmosphere)
SEIKO Instruments Inc. DSC and TGA
Thermochemical & Electrochemical Material Processing Laboratory

Primary Researcher(s) / Coordinator(s):
Prof. Dr. İshak Karakaya

General Information:
Thermochemical and Electrochemical Materials Processing (TEMP) Laboratory is devoted to do research and development on materials (ppp) 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.

Equipment:
- GAMRY Potentiostat/Galvanostat/ZRA Reference 3000
- Agilent N6700B Power Supply
- Lindberg Vertical Split Tube Furnace
- Electrobalance-CAHN1000
- Gas mixing and analyzing equipment
- pH meters, high temperature furnaces
- Vacuum pumps, hot plates
- Gas mixing and analyzing equipment
- Fischerscope XDAL-XRF
- Mitutoyo SJ-400 profilometer
Turbine and High Temperature Materials Technology Laboratory

Primary Researcher(s) / Coordinator(s):
Assist. Prof. Dr. Bilge İmer

General Information:
TAHT group is focused on improving surface and structure quality of high temperature turbine coating materials technologies such as Al-transition metals bond coats along with underlying substrate, thermal barrier coatings (TBC), and high temperature processed hard coatings such as TiN, TiC, BN, BC, SiC.

Equipment:
Chemical Vapor Deposition (CVD) Alluminizing System
High Temperature CVD System
High Temperature Vacuum Diffusion/Brazing Furnace
Pressure Feed & Suction Feed Shot Peening Machines
Metal Film Thickness Measurement (Calotest)
Surface Profilometer
Welding Technology and Non-Destructive Testing Center

Primary Researcher(s) / Coordinator(s):
Prof. Dr. Hakan Gür

General Information:
http://www.wtndt.metu.edu.tr

Equipment:
Hybrid-plasma arc welding system

Conventional welding equipments for gas welding;

Manual metal arc welding, MIG/MAG, TIG and Spot Welding

Hot Cracking (MVT) and Cold Cracking Testing (implant) Facilities

Digital (4) and analog (7) ultrasonic test devices

Phased-array device

Radiography (4 X-ray units: 150-420 kV);

Magnetic particle testing (7 magnetization equipment, universal bench)

Penetrant testing systems

Mechanical Testing Equipment (tension, elevated temperature tension, bending, hardness, impact test, LVDTS, crack gauges)

Machining 3-axis CNC machine, vertical milling machine, horizontal milling machine.
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