



UNIVERSITY OF MISKOLC
Faculty of Materials Science and Engineering
Antal Kerpely Doctoral School of Materials Science
and Technology



Surface Treatments/Technologies (Coatings and Surface Modification Techniques)

Dr. Tamás I. Török

COURSE DESCRIPTION

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Surface Treatments/Technologies

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Teacher

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<http://www.metont.uni-miskolc.hu>.

Subject offered

To all the students registered in the Doctoral School.

Language

Hungarian and English

Main goals

It is aimed at informing the students about the most recent and advanced surface treatment techniques related to the metals technologies (metallurgy) and metals surface engineering (cleaning, pre-treatments, surface modification, coatings and post-treatments).

Capabilities to be acquired

The students should gain wide ranging and fresh knowledge about the surface finishing techniques applied to improve the specific and functional surface properties of objects produced and processed mainly of metals and alloys. After completing the course the students should be better prepared to design and control surface engineering processes. The acquired knowledge may help anyone's successful progress in his/her studies registered in the Kerpely Doctoral School.

Methodology

The students will be given lecture notes, scientific papers and other teaching materials to help and facilitate their studies, plus regular consultations will also be offered and arranged to discuss the contents of the subject. At least one presentation is also requested from each student about a surface engineering topic most closely related to his/her doctoral research theme.

Syllabus

Surface technologies (surface treatments, surface modifications, coating techniques) – description and characterization based on different aspects like function, thrift, environmental safety, reuse and recycling, saving energy and materials.

Characterizing, testing and qualification of surfaces and surface conditions in view of their circumstances in use. Surface degradation processes: contamination, aging, wear and corrosion.

Surface modifications (fine cleaning, surface activation) and deposition of thin films from the gas phase via layer growth under reduced pressure (in vacuum). Physical vapour deposition (so-called PVD) and chemical vapour deposition (so-called CVD) and some related techniques.

Development of coatings from molten materials: thermal spraying (flame spraying, plasma spraying etc.). Examples of their new and novel applications in metals processing and manufacturing industries (energy production, turbines, automotive industry).

Corrosion protection of steel structures by hot-dip galvanizing (Zn coating). Batch type and continuous metal coating technologies; the evolution and application of new alloys, and specialities of the so-called duplex protection. Glassy (vitreous) enamels on steels: vitreous enamelling technologies and Glow Discharge Optical Emission (GD OES) in depth analysis of the enamel coatings.

Organic (lacquers, paints, and rubbers) coating systems and their applications in different industries (building industry, metals industries, and manufacturing of consumer products). Quality testing, reparation and maintenance of organic coatings.

Surface preparations and pre-treatments (cleaning, washing, rinsing, activation, conversion coatings) and electrochemical or chemical deposition (electroplating) of metals and alloys from aqueous electrolytes. Case studies: Cr(VI)-free electrolytes and conversion, phosphating and its alternatives, anodising of aluminium, electroplated coatings (Cu, Ni, Zn, Sn, Au, Ag, etc. and their alloys) both on electrically conductive and nonconductive substrates and products.

Relevant literature

1. D.R. Gabe: Principles of Metal Surface Treatment and Protection, International Series on Materials Science and Technology Volume 28, Pergamon Press, 2nd Ed., 1978.
2. P. Møller, L.P. Nielsen: Advanced Surface Technology, Volumes 1 & 2, NASF 2013
3. Modern Surface Technology, Eds.: F.-W. Bach, A. Laarmann, T. Wenz, Wiley-VCH 2006
4. Surface Engineering Volume 5. ASM Handbook Series.

+ Additional literature sources and relevant scientific papers would also be offered to the students if necessary..

Final exam

Oral presentation of a study report and oral questioning/discussion at the final exam.

Complex questions

1. Description and characterization of surfaces and techniques for studying/testing their surface conditions.
2. Solid thin film deposition techniques from gas phase and characterisation of such deposits by a detailed analysis, for example, of the diamond like carbon (DLC) coatings.
3. Description and characterization of coating systems applied primarily for the corrosion protection of carbon steels, and detailed analysis of one of them like, for example, hot-dip galvanizing (Zn coating).
4. Mechanism of the bond formation between the steel substrates and vitreous enamel coatings together with the quantitative analysis/testing of the bonding zone by in depth Glow Discharge Optical Emission Spectrometry (GD OES).
5. Modern destructive and non-destructive testing techniques first of all for analysing organic coating layers/systems.
6. Detailed description of the unit operations of the electroplating technologies (for example that of zinc electroplating) and specific parameters and features of the controlling system.