Faculty of Metallurgy and Materials Science and Faculty of Sciences, Dunarea de Jos University of Galati

Interfaces-Tribocorrosion and Electrochemical Systems Laboratory (L.I.T.E.S.)

Research activity in Nano and Micro Materials by: Micro and nano deposition of dispersed particles with metals and alloys to obtain functional surfaces in TRIBO - and BIOTRIBO - CORROSION SYSTEMS. (1)

Assoc. Prof. Dr. Lidia BENEA

Expertise and experience of the researcher:

Expert Evaluator: European Commission – RDG Science Research and Development, Engineering Science Panel, INTAS, CEEX and CNCSIS.
Chairman of WP 18 Tribocorrosion - Knowledge dissemination and training, European Federation of Corrosion
10 Prize and Diplomas at Scientific National Conferences for scientific and technical presentations.
Expertise: New materials obtained by co-deposition of particles with metals from obtaining technologies to properties investigation. Mico and nano structured Materials.
Expertise on surface treatments by electrodeposition of metals, alloys and composite materials to improve the corrosion and wear resistance of materials.
Electrochemistry and corrosion.
Research experience in the field of tribocorrosion of coatings and passivating materials.
Role in the group and his complementarity:
Research on surface modifications technologies to improve the corrosion and wear resistance of materials.
Corrosion and wear corrosion (tribocorrosion) of materials (mechanisms and kinetics).
New materials obtained by co-deposition of particles with metals.
Research of materials degradation by surface analysis techniques.

PARTENERS:

1) Ecole Centrale Paris, LGPM ("Laboratoire de Genie des procedes et materiaux"), (France)
2) Katholieke Universiteit Leuven, Department of Metallurgy and Materials Engineering (Belgium)
3) Trento University, Department of Materials Engineering, Laboratory Anticorrosione Industriale (Italy).
4) Bay Zoltan Foundation, Institute for Materials Science and Technology (Bayati) Hungary.
5) École Nationale Supérieure des Mines de Paris, Matériaux (France)

RESEARCH PROJECTS:

1) COBIL Romania - France : BRANCUSI: 19/08930OL: Etude de dépots composites nanostructurés, pour la protection des surfaces métalliques contre la tribocorrosion. 2005-2006. Project Manager: Lidia Benea (RO) – François Wenger (F)
2) International bilateral cooperation project between Romania and Belgium (Flanders): "Dunarea de Jos" University of GALATI, Romania - Katholieke Universiteit Leuven, Belgium): 2003-2005: Tribocorrosion of engineering materials in view of their industrial use as sliding parts in pumps, shafts, and motors operated in water-lubricated conditions: i) Inventory and effectiveness of biodegradable additives to water for achieving low friction and high wear resistance, ii) Mechanism of degradation and restoration of triboreactive surface layers on sliding engineering materials immersed in water".
Project Manager: Lidia Benea (RO) – J.P. Celis (Be).
3) GRANT CNCSIS TIP A 1347 (2005-2007): Director: Lidia BENEA: Nanostructured Composite Coatings Obtained by Electrodeposition for Surface Protection in Tribocorrosion Systems.
4) COST D19 CHEMISTRY: Chemical functionality specific to the nanometer scale.
Member of Management Committee and Project Manager: Lidia BENEA.
Project: Nanostructured composite coatings obtained by electrodeposition - processing and properties characterisation.
2003-2007.
5) COST 532-TRIBOSCIENCE AND TRIBOTECHNOLOGY;
Project Manager: Lidia BENEA. Project M1 title: Nano-structured composite coatings obtained by electrodeposition to be used in tribocorrosion systems: processing and properties investigation;
2003-2007

GENERAL PRESENTATION

Following the European Commission concept on promoting nano-technologies and nano-sciences, knowledge based multifunctional materials and new production process our project aims to multidisciplinary studies of functionally surfaces obtained by electrodeposited micro- and nano-structured composite coatings. New structured materials by codeposition of micro and nano-metric sized dispersed particles with zinc, nickel, copper cobalt and alloys are obtained. The mechanism and kinetic of codeposition are studied by the following techniques: electrochemical impedance spectroscopy, potentiodynamic cathodic diagrams and current – potential transients. The properties characterisation is correlated with the performances requested in the field of uses as functional surfaces to improve the corrosion and wear resistance in the functional systems. By high level techniques as scanning and transmission electronic microsopy as well as atomic force microscopy and ultrahigh microtopography the correlation between micro and nano - structures obtained and modification induced by dispersed particles are done.
A model allowing us to describe the formation of tribochemically induced surface layers starting from single asperities interactions to macroscopic effects are obtained by studying the mechanism and kinetic of complex degradation of passive triboreactiv layer. Two major objectives are: 1. TEACHING by doing research in the field of micro nano-materials and their importance in the complex mechanism of synergetic corrosion and wear degradation. 2. ELABORATING the micro and nano- structured composite coatings and predictive models of their behaviour in the tribo-corrosive systems. The joint works must allow the partners to put together their expertise and know-how in a prospective survey on the corrosion, friction and wear behaviour of micro and nano- structured composite coatings in corrosive and wear environments and to develop the high-level scientific collaboration between our group and foreign partners from 1997 began.

Results in Micro- and Nanoscience (1)

• Electrochemical methods (cathodic polarisation and electrochemical impedance spectroscopy diagrams performed at cathodic potential) to study the influence of dispersed nanosized and microsised dispersed particles on the mechanism of nickel electroreduction.
• Surface characterisation of composite coatings obtained by SEM, and EDX.
The composite coatings have been obtained by electrodeposition using two types of dispersed phases: nanosized SiC (20 nm mean diameter) and microsized SiC (30 μm mean diameter).

Influence of nano and microsised SiC particles on nickel electrodeposition was observed by potentiodynamic diagrams and electrochemical impedance spectroscopy measurements performed with and without dispersed particles. The addition of micro and nano sized dispersed particles displaces the nickel reduction diagrams to more positive potentials. The shift in reduction potential were attributed to an increase in the active surface area due to the adsorbed particles on the cathode and to a possible increase in ionic transport by dispersed particles with their ionic layers adsorbed. An example of impedance diagrams obtained by codeposition of nanosized SiC (20nm) with nickel and pure nickel electrodeposition is presented on Figure 1.

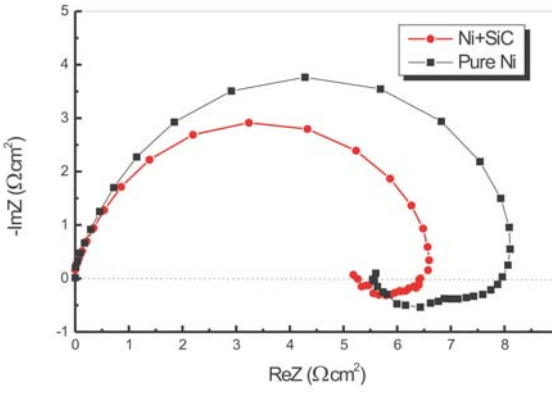

Fig. 1. Impedance diagrams performed at cathodic potential of –750mV (Ag/AgCl): (solid circle)-codeposition of nano-SiC with nickel (50 g/l SiC in the electrolyte), (solid square)-pure nickel electrodeposition.