coatings

*Editorial*

# Surface Treatment of Metals

**Petrica Vizureanu** [1,2]

[1] Faculty of Material Science and Engineering, Gheorghe Asachi Technical University of Iasi, D. Mangeron St. 41, 700050 Iasi, Romania; peviz@tuiasi.ro
[2] Materials Science and Engineering Department, Technical Sciences Academy of Romania, Bulevardul Dacia 26, 030167 București, Romania

The main objective of this Special Issue was to publish outstanding papers presenting cutting-edge research in the field of surface treatment for metals.

Nowadays, many surface treatment technologies are available in addition to advanced characterization techniques. The Special Issue gathers several outstanding articles on topics ranging from ferrous alloys (steel, cast iron) or magnetite nanoparticles/nanowires to non-ferrous alloys or amorphous materials.

The focus of this Special Issue was on a newly developed system of alloys (Ti15MoSi) coated with ZrO2, which is a solution to improve the corrosion behaviour, biocompatibility, and the durability of human tissue [1]. It was revealed that zirconia is much more stable in simulated body fluids (SBF) and has no side effects during the healing process of bone. The research highlighted the morphological aspects of zirconia coatings on the new alloy of titanium substrate, demonstrating better behaviour due to a more adherent coating. Additionally, it was observed that the Young modulus of metallic alloys is close to biological bone, which will avoid the stress shielding of the implant during the patient's life.

A different approach was discussed in order to evaluate the mechanical components of the pumps coated with various types of wear-resistant coatings. In Ref. [2], AMDRY 1371 (Mo–NiCrFeBSiC) coatings were applied with the atmospheric plasma spray (APS) method on some steel samples fabricated from a worn piece from an irrigation pump. New findings were presented regarding the wear modes of the coatings, highlighting the best value of coating thickness, according to the running conditions. Additionally, correspondences were established between the technological processes and materials properties, emphasizing a world class technology for the revamping the turbine blades. Another relevant study [3] highlighted a methodology to design the best contact profile of the surface for an earthmoving machine, ensuring the force allowance across the cutting elements during the excavation/extracting hydrocarbons. The importance of the research was confirmed by improving the profile design of the devices working in hard conditions in permafrost areas [4].

Thin films were another focus of this Special Issue: the optical and electrical properties stability of poly(3-hexylthiophene) (P3HT) thin films sensitized with nitromethane ferric chloride (FeCl3) solution [5] and the effects of electromigration with and without thermal ageing of 0.05 wt.% Ga addition to the Sn–0.7Cu solder [6]. The optical properties optimization was studied by spectrophotometry and ellipsometry and electrical characterizations, electrical resistivity investigations were achieved. The aim of the research was to investigate the heating cycles, in dark and under illumination, of the electrical properties of sensitized polymer films. An investigation of the formation of tin (Sn) whiskers in the thin Sn–0.7Cu–0.05Ga Pb-free solder under the influence of electromigration and thermal ageing for surface finish applications was performed. The results show that the addition of 0.05 wt.% gallium (Ga) decreased the Sn whisker's length and growth density while simultaneously refining the IMC layers, while the addition of Ga resulted in a decreasing Sn whisker formation and a refining of the IMCs, while also increasing the shear strength of the Sn–0.7Cu solder by ~14%.

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One study demonstrated an interesting approach to diffusion surface treatment followed by a laser heat treatment (LHT) procedure [7]. Low-alloy and medium-carbon 42CrMo4 steel was treated by changing nitriding potential and the nitrided layer was obtained with $\varepsilon + (\varepsilon + \gamma')$, a compound zone of 19.35 mm thickness and a diffusion zone with the nitric sorbite and $\gamma'$ precipitates. Conclusions were taken into consideration regarding the parameters of the laser process together with gas nitriding concentration and temperature distribution. In this way, laser-nitrided layers with improved structural properties were obtained.

Finally, another important study [8] succeeded in emphasizing the feasible benefits by sulphur diffusion blocking at the metal–mold interface. The structure analysis and graphite nodularity were achieved using a thin steel sheet at the metal–mold interface demonstrating the behaviour of the casting skin thickness.

The entire spectrum of topics presented in this Special Issue emphasize the newest findings regarding ongoing research in this field. Such a compilation can be an inspiration for the further development of multifunctional and sustainable coatings, revolutionizing the materials coating engineering of the future. All these published studies offer new approaches for further researches, in order to create a sustainable society based on developing knowledge of the surface treatment of metals.

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