11th International Conference
on Advanced Materials

ICAM2009

Rio de Janeiro Brazil
September 20 - 25

# Surface properties of carbonic coatings developed on iron-based alloys by surface electrochemical engineering techniques

V. A. Andrei(1)*, C.Lungu(2) , C. Diaconu(1) , G.Oncioiu(1) and O. Rusu(1)

(1) Surface Analysis Laboratory, Institute for Nuclear Research 115400 Pitesti, Romania , andvic12@yahoo.com
(2) National Institute for Laser, Plasma and Radiation Physics, 077125, Magurele-Bucharest, Romania, cristian.lungu@inflpr.ro
* Corresponding author.

**Abstract** – Carbonic coatings were developed on iron based alloys used as structural materials, by various Surface Engineering techniques which include: a) Plasma Electrolysis treatments (PE); b) Electrochemical deposition; c) Carbonic films deposition in Thermionic Vacuum Arc Plasma (TVA). The structures obtained in various experimental conditions, were characterized by correlation of the results of the complementary techniques: XPS, "depth profiling", XRD, LAXRD, EIS.

DLC adherent layer was deposited on selected PE treated substrates.

Duplex treatments which include plasma electrolytic techniques are extremely useful where, in practical tribological situations, the application of a liquid lubricant is impossible and a thin top layer of a material with lubricious properties should be applied as part of a surface composite coating[1].

Presently, there is great interest in deposition on various substrates of amorphous carbon (a-C) films, which contain significant fractions of $sp^3$ bonding[1,2]. Diamond-like carbon (DLC) is a well-known anti-friction and wear-resistant material. Thin DLC films deposited by various methods, usually suffer from a lack of load support when deposited on soft and ductile substrates, such as austenitic stainless steels.

Carbonic coatings were developed on iron based alloys used as structural materials, by various Surface Engineering techniques which include:

- Plasma Electrolysis treatments - (PE): the steel substrates were modified by nitruring and nitro-carburising plasma diffusion treatments;

-Electrochemical deposition: a solutionof acetylene in liquid amonia was employed as the electrolit;

-Carbonic films deposition in Thermionic Vacuum Arc Plasma (TVA).

The carbonic coatings obtained in various experimental conditions were characterised by correlation of the results of the complementary techniques: XPS, "depth profiling", XRD, SAM, LAXRD, EIS; the performance evaluation (corrosion resistance, mechanical properties) of the carbonic protective coatings is analysed function of the treatment parameters.

The experimental conditions for deposition of adherent DLC coatings are identified.

An overall description of the processes involved in the surface properties improvement is presented.

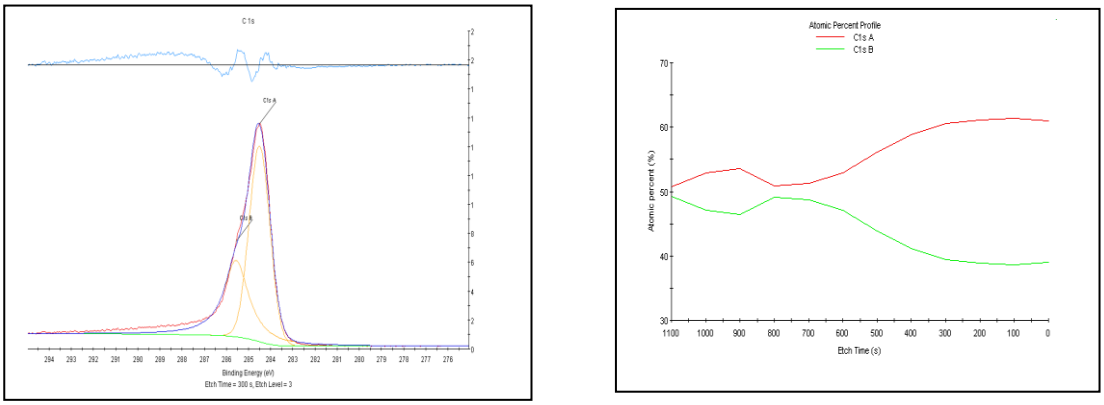


**Figure 1.** XPS analysis of carbonic deposited layer on nitro-carburized 304 austenitic stainless steel: Chemical state of C (C1s A=$sp^2$; C1s B =$sp^3$)

**References**

[1]*A. Matthews, A. Leyland, A.Yerokhin, T.Pilkington*, IGR Report:EPSRC Grant No.GR/ R15696

[2]*V. Andrei, E. Andrei, Gh. Vlaicu, C. Stihi, G. Dima, C. Oros, S. Dinu*, J of Optoelectronics and Advanced Materials, vol.9, No.7, 2007, p 2291-2296