Surface Properties of Polymer Films obtained by Atmospheric Pressure Plasma Jet on SAE 1020 Steel

L.L.G. Silva[1,2], N.A. Ferraz[1,2], V. Prysiazhnyi[2], K.G. Kostov[2]

[1] *Faculdade de Tecnologia de Pindamonhangaba – FATEC, Pindamonhangaba, SP, Brazil*
[2] *Faculdade de Engenharia de Guaratinguetá – FEG, Universidade Estadual Paulista – UNESP, Guaratinguetá, SP, Brazil,*

In this work polymer films were deposited on SAE 1020 steel by an atmospheric plasma jet system using hexamethyldisiloxane (HMDSO) monomer as polymerizing agent. Several experimental parameters, such as, deposition time, deposition mode (continuous deposition and deposition alternated with surface activation) and voltage waveform were varied. A decrease of the water contact angle from 98° up to 28° was observed for the samples without and with deposited film, respectively. As evidenced by SEM the polymer films exhibited a cauliflower structure, which can also influence the surface wettability. The results of electrochemical measurements presented a slight improvement of the corrosion potential and corrosion current density of SAE 1020 steel after the HMDSO film deposition.

1. Introduction

Nowadays there exist several methods to obtain polymer films for corrosion protection. However, in the most applications; the reactors are operated at low pressure, which requires an expensive vacuum system. Plasma deposition at atmospheric pressure has emerged as an alternative approach because it is economically favourable and environmentally friendly. However, still there are few studies about atmospheric plasma deposition on the metallic surface. Lommatzsch et al. grew HMDSO films on aluminium by using atmospheric plasma jet [1]. This work deals with the study of plasma jet deposition of HMDSO films on SAE1020 steel.

2. Experimental

The plasma jet system consists of a 18.0mm-diam Pyrex tube terminating with a horn-like nozzle, HV electrode placed inside it and a grounded electrode covered by glass table beneath the tube. Plasma was excited by an AC power supply operating at 19.0 kHz and voltage amplitude of 15.0 kVp-p. The device was flushed with 1.0 L/min argon flow and a mixture of air/monomer at flow rate of 0.1 L/min was introduced. Samples (12.5 mm diameter discs SAE 1020 steel) were exposed to plasma for 5 to 20 min. at a nozzle-to-sample distance of 6 mm.

3. Results and Discussion

The water contact angle decreased from 98° for the uncoated sample up to 28° for the coated sample. Therefore the HMDSO film deposition using plasma jet led to a hydrophilic surface. As evidenced by the Fig. 1 the film consists of cauliflower structures with many pores that allow spreading of the water drop.

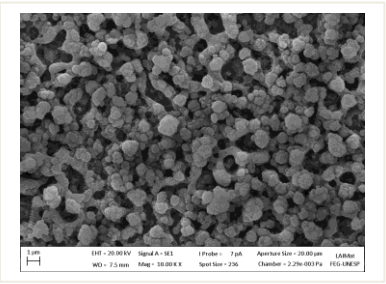

Figure 1: SEM image of HMDSO film (10,000 X)

As shown in the figure 2 the coated sample presented a nobler behavior because its corrosion potential is more positive (-0,59V) when compared to the standard sample (-0,62V). The same behavior was observed in the open circuit potential curves. The coated steel sample presented a corrosion current density of about 1.5 x 10^{-6} A/cm², which is slightly lower than the reference one.

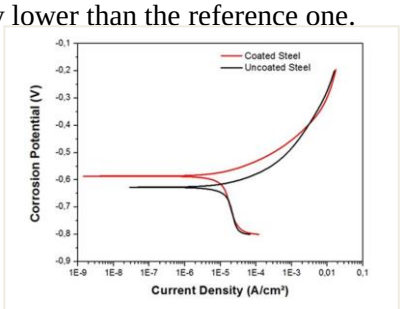

Fig. 2: Polarization curves of steel samples

4. References

[1] U. Lommatzsch, J. Ihde, Plasma Processes and Polymers. **6**, (2009) 642.