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Corrosion study of Neodymium-Iron-Boron alloys: Neutron reflectometry of the ultra-thin polymer film interfaces and effectiveness of polymer coatings

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Abstract : Neodymium-iron-boron alloys are very sensitive, particularly to the air humidity. The aim of this work is to study the effectiveness of polymer coatings against corrosion in the cases cited above. This work is financially supported by the Research Thematic Agency in Science and Technology. In this context we introduced the neutron reflectometry to study the ultra-thin polymer film interfaces of polymethylmethacrylate (PMMA). Reflectometry experiments were conducted at the nuclear research center of Draria (Algiers). The preparation of the PMMA films is performed by means a technique based on depositing a thin film on a planar solid surface. This method known as the “spin-coating’’ provides dense, homogeneous materials very thin after a rapid evaporation of the total solvent. First, we realized calibration settings "zero" reflectometer: one seeks the zero position of the detector, the optimal position of the sample and its angle of rotation. The measured reflectivity as a function of the scattering vector Q, gives information on the thickness of layers, roughness of multilayer system. From the spectrum of the reflectivity vs. the wave vector (scan ?-2? of the PMMA film), we find a thickness of the PMMA film. Electrochemical measurements were performed in a three electrode cell using an VoltaLab Master4, Model 273A potentiostat. The samples of Nd-Fe-B magnets covered by the PMMA film are used as working electrode in the NaCl (0.5M) solution, a platinum wire as counter electrode and a saturated calomel electrode (SCE) as reference electrode. The polarization parameter values, corrosion current density (Icorr) and the polarization resistance (Rp) were determined. The corrosion rate values obtained show interesting perspectives for our work. The corrosion resistance is improved in the presence of PMMA layers. We note that for variable thickness of PMMA film 485nm and 1,5µm the polarization resistance are 518?cm² and 6550?cm² respectively. The corrosion rate values obtained show interesting perspectives for our work. The corrosion resistance is improved in the presence of PMMA layers

Keywords : rare earths, magnet, corrosion, polymer coatings