NITROGEN-RICH STAINLESS STEEL THIN FILMS OBTAINED BY MAGNETRON SPUTTERING

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INTRODUCTION

Reactive magnetron sputtering is a versatile tool for producing coatings on various substrates also at low temperature. The use of stainless steel targets and different nitrogen-containing plasma mixtures allows to obtain nanostructured coatings consisting of a wide range of single or multiphase layers. In the present study, ferritic and austenitic stainless steels were used as targets and different coatings were deposited by magnetron sputtering varying the relative volumetric nitrogen content in the treatment atmosphere. XPS, XRD and electron microscopy analyses were employed to characterize the obtained samples.

MATERIAL AND METHODS

AISI 316L and AISI 430 targets (diameter: 50mm; thickness: 1 mm) were obtained from mirror finish sheet plates. As substrates, samples of 30x15x1mm obtained from the same sheets, glass and Si (100) wafer were used. Coatings were deposited by magnetron sputtering (Korvus Technology HEX system with DC and 13.56MHz RF sources) without bias, at different temperatures and with 0%,15% and 30% N_2/Ar volumetric ratio. The film morphology was investigated by electron microscopy, the composition was determined by XPS analysis and the phases were determined by XRD analysis using a constant 10° incidence angle configuration. Preliminary corrosion behaviour was studied in 5% NaCl aerated solution at room temperature by means of the potentiodynamic method.

RESULTS AND DISCUSSION

The samples showed a mirror-like surface with a good adhesion to the substrate and uniform surface morphology. The coatings, having a uniform thickness of about 500 nm, show a nanostructured columnar morphology with smaller grains at the interface. The nitrogen amount in the films increases as N_2 content in the atmosphere is higher. In the used conditions amorphous, nitrides and supersaturated phases, as the so called S phase, were obtained. The deposition temperature influences the crystallite sizes and preferred orientations of the present phases. The corrosion tests, performed on selected samples, show that the nitrogen containing films have an improved corrosion resistance. The incorporation of nitrogen in the film during the reactive plasma process stabilizes and leds to lattice expansion of the austenite phase even using a ferritic target. Amongst the various phases produced in SS–N films by reactive sputtering, the S phase is the most interesting since it provides a range of attractive mechanical and corrosion properties. This research was funded by Regione Toscana within Por Creo Fesr 2014–2020, “Thin Fashion” project (CIP CIPE D55F17000240009).