PHOTOELECTROCHEMICAL AND CAPACITANCE STUDIES ON ALUMINIUM OXIDE FILMS

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Publicado em: *Livro de Resumos do 8th International Symposium on Electrochemical Methods in Corrosion Research - EMCR 2003, Ysermonde, 2003*

Corrosion protection of metals and alloys is often achieved by the formation of passive oxide films, which usually exhibit semiconductive properties. The resistance of the metal to corrosive attack has been found to depend upon the solid-state characteristics of the oxide film. In this frame, photoelectrochemical spectroscopy and capacitance measurements (Mott-Schottky approach) have been successfully used in the past as in-situ techniques for the characterization of passive films formed on different metals.

Although Al_2O_3 has been usually reported in the literature as an insulator, with a bandgap ranging from 8 to 9 eV, recent studies of the oxide films formed on aluminium seem to indicate that they show n-type semiconducting properties, with optical transitions ranging between 2.8 and 4.5 eV. The relationship between the solid-state properties of Al oxide films and its corrosion resistance has been studied through different approaches. McCafferty reported a dependence of the pitting potential on the flatband potential and the isoelectric point of the oxide. Similar results were presented by Menezes et al, who found out that E_{fb} increases with the tendency of Al to undergo pitting. On the other hand, Di Quarto has related the photoresponse with the different structure of the surface passive layers.

On this basis, the above-mentioned techniques were used in this work to assess the electronic properties of the oxide films formed on pure aluminium and 2024-T3 aluminium alloy under different conditions.The results obtained confirm that the oxide films formed on aluminium show a semiconductive behaviour, with bandgap energies that are identical for the oxides studied, despite their different characteristics. Moreover, from the capacitance measurements performed on commercial aluminium it is

possible to ascribe an n-type semiconductive behaviour, in accordance to the literature.

It was found out that capacitance measurements may be used as a valuable technique for the assessment of the quality of anodised layers, allowing the distinction between an efficient and an inefficient sealing. Therefore, they may be used to predict the corrosion resistance of these materials.