Films Deposited from Red Mud by PIIID

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Abstract

The production of aluminium begins with extraction of alumina from bauxite ore via the Bayer Process. During this process, the waste components of the bauxite ore are separated, generating an insoluble residue called red mud. Red Mud is generally characterized as complex slurry of mixed oxides with traces of heavy metals in a highly alkaline matrix. Thus, the safe disposal and reuse of red mud has attracted much attention in recent years. The aim of the present study is to characterize the Brazilian Red Mud and investigate the possibility of using it as a precursor for the production of plasma sputtered alumina-containing thin films, using an innovative procedure. This procedure consists of spreading 0.8 g of the Brazilian red mud powder on the bottom electrode of a capacitivelly coupled plasma reactor. Argon is injected up to the working pressure of 1.4 Pa and the plasma is ignited by the application of radiofrequency power (13.56 MHz, 300 W) to the lowermost electrode. The sputtering of the red mud components by ionic bombardment provides precursors species for the film growth. Substrates are attached to the upper electrode to collect the films. Simultaneously to the plasma excitation, rectangular high voltage negative pulses (1.5 kV, 300 Hz) are supplied to the sample holder (upper electrode) to promote ion bombardment of the growing layer. It was investigated the effect of the ion bombardment on the structure, deposition rate, chemical composition and morphology of the films. The chemical composition of the Brazilian red mud was determined using an Inductively Coupled Plasma Mass Spectrometer (ICP- MS) at Acme (Analytical Laboratories LTDA, Vancover, Canada). Iron, Aluminum and Siliceous Oxides are the main encountered components. Deposition rate was evaluated from film thickness and deposition time. The thickness was determined as the height of steps delineated during film deposition, measured in a profilometer Veeco Dektak 150. The infrared reflectance absorbance spectroscopy method was employed to derive the chemical composition and molecular structure of the films. The morphology of the coatings was determined by scanning electron microscopy in a JEOL 840A equipment. An X-ray diffractometer Philips X'Pert was used to investigate the precipitation of crystalline phases in the layer structure. Components of the red mud as alumina and silica were detected in the film. The results of this study suggest that it is possible to produce films from red mud with interesting properties for practical applications.

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