LECTURE/ME11

CORROSION AND PROTECTION STRATEGIES FOR LONG-TERM DURABILITY OF METALLIC MATERIALS

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Degradation is a mechano-chemical phenomenon which impacts all materials, e.g. solar panels, wind and marine turbines, cultural heritage, biomaterials, etc. These materials are affected by degradation under the environmental conditions where they are employed, depending on the purpose of the application. The loss of material properties and its replacement is expensive; therefore, both the durability and the green recovery of materials are paramount for a circular economy in the modern industry. Concerning metallic materials working in the environment, the deterioration is produced as a consequence of a corrosive process carried out at room temperature, which consists in an electrochemical process in which two reactions occur: an anodic oxidation reaction and a cathodic reduction reaction in an electrical conducting electrolyte. If the purpose is to increase the durability and therefore increase the operational lifespan of these materials, first of all it is required to determine the material degradation kinetics through precise techniques of high accuracy and sensibility levels like electrochemical techniques. Electrochemical methods provide robust data regarding the current material properties which are used to determine the functionality status of the material and the possible need of material replacement or the viability of suitable protection methods to enhance its durability. Specifically, in this lecture, metallic biomaterials will be used as an example to understand the material deterioration via electrochemical techniques such as electrochemical impedance spectroscopy as well as the proposal of application of protective techniques to improve the operational durability of the materials via surface modification and functionalization strategies.

Keywords: Corrosion, protection, durability, electrochemistry, biomaterials, metallic.