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WITHDRAWN Neutron Reflectometry: A non-destructive probe for in-situ corrosion monitoring in Cu-Ni (90/10) alloy

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Neutron Reflectometry (NR) is an ideal technique to study chemical reactions at surfaces and interfaces because it is a non-destructive technique which can determine in-situ the chemical profile in a film with nanometre resolution. Therefore, NR can provide information on the metal and oxide layer thickness and the changing interfaces between metal and oxide layer as well as oxide layer and an aqueous environment, thereby investigating the corrosion process on the atomic scale. The Cu-Ni (90/10) alloy is an interesting material from its corrosion resistance property and is being used in many industries including marine and nuclear applications. The accelerated corrosion of this alloy in seawater under certain conditions has been attributed to the breaking and removal of the passive Cu2O/CuO layer. According to this picture, the density of the Cu2O/CuO passive layer, as well as the film thickness, should start changing at the onset of the corrosion process. To date, this phenomenon has not been observed directly and in situ. In this study, we used NR to monitor the surface corrosion to get insight into the passive layer modification during the very early stages of corrosion. We prepared 60 nm thick Cu90Ni10 films on Si wafers using DC magnetron sputtering and exposed them to simulated seawater and to a similar seawater but contaminated with sulphur, and measured neutron reflectivity as a function of time. The first experiment (i.e. without sulphur) showed that the reaction at the surface starts after a few minutes and progresses slowly. In contrast, in sulphur polluted seawater (10 ppm S) the reaction was much faster.

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