In-situ study of corrosion phenomena on electronic devices by local electrochemical techniques

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Nowadays, due to living in an era of highly sophisticated electronic and communication technology, micro- and nano-electronic devices have extended to all aspects of our daily life. Corrosion deterioration in the micro/nano scale of designed materials for electronic devices (e.g., Integrated Circuit (IC), Printed Circuit Board (PCB), and electronic components), in which a number of metallic components exist in different forms, leads to decrease in the electrical performance, efficiency and lifetime. Due to a colossal ratio of the surface to the volume of small-scale electronic devices, corrosion deterioration including galvanic coupling, crevice corrosion, and even uniform corrosion significantly influences the lifetime and the nature of the devices. Fundamental understanding of corrosion mechanisms of miniature electronic devices in their service environments could lead to the superior long-term stability of the system through a knowledge-based design of materials and protective coatings. The objective of this work is to obtain a comprehensive understanding of the localized corrosion mechanism of the metallic component of the electronic devices by applying surface analysis and scanning electrochemical techniques with high-spatial resolution. In addition, new configurations of the localized techniques for the application in micro- and nano- electronic components are verified. In order to achieve this, Atomic Force Microscopy (AFM), Scanning Kelvin Probe Force Microscopy (SKPFM), Scanning Electrochemical Microscope (SECM), and Field Emission Scanning electron microscopy (FE-SEM) are used for some model specimens along with different corrosive environments to investigate in-situ corrosion phenomena. Combining the morphological and electrochemical techniques provides complementary information to introduce in-situ corrosion mechanism, (i.e., sustainable sites for initiation, and preferable direction of corrosion propagation) of the electronic devices failures.