CORROSION SENSING - ADVANCES IN

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Life prediction of structural components and functional materials is vitally important to safe operation of aircraft systems and reduction of corrosion maintenance costs. Since major structural and functional materials failures have been attributed to corrosion related damage, methods to detect and/or monitor corrosion are essential to life prediction. The factors that cause crevice and pitting corrosion, hidden corrosion like exfoliation of joints and edges, fatigue and stress cracking need to be monitored early. Devices are required which perform diagnostic and prognostic analysis. Essentially, two classes of diagnostic tools or devices are required: one that can monitor the corrosive environment in which aircraft operate or perform, and the second which can find where corrosion related damage exist. The cost of aircraft corrosion is in billions of dollars for the U.S. Department of Defense and has been realized as a major cost driver. Corrosion is mostly responsible for high maintenance cost of aging platforms and has impacted readiness and reliability of military equipment during operations and conflict. These circumstances provided an impetus to seek technologies which can reduce both operational cost and maintenance dollars via smart monitoring and inspection tools. Knowing where the problem is, and early, will save up to 30Hidden corrosion is most difficult to detect and monitor without disassembly. A good corrosion detection and/or monitoring system should be capable of finding corrosion or detecting the onset of corrosion in any location, so that the effect of protective measures or changes in process variables can be evaluated under actual operating conditions. The system should be smart and capable of rapid response to permit solutions for urgent problems to be tested and applied immediately. The inspection tools which can detect existent corrosion under the paint and skin of aircraft, second and third layer joints and assemblies must be dependable (with no false calls) and promise high probability for detection. The devices or monitoring techniques must be cost effective also.

The advances in developing corrosion detection and monitoring techniques are primarily based on the phenomenological concepts and principally deal with the changes that could or may have occurred in the chemistry and physics of surfaces of the material under investigation. Although corrosion is an electrochemical phenomenon, many concepts to detect corrosion have evolved from fields of scientific discipline other than electrochemical. In fact only few are derived from chemical or electrochemical principles. Generally, they can be classified in the following types of categories: (1) chemical or electrochemical response; (2) visual or optical interference; (3) change in the magnetic field; (4) acoustic and/or ultrasonic interference; (5) electromagnetic emissions and/or temperature gradient; (6) x-ray or radiography; and (7) change in electrical resistance. A number of techniques also employ a multiple of these concepts to develop a versatile tool with high probability for detection. This presentation will review some of these advancements.