Effect of Surface Contamination on Composite Bond Integrity and Durability

Dwayne McDaniel, *Ph.D.* – Applied Resesarch Center, Florida International University
Tomas Pribanic - Applied Resesarch Center, Florida International University
Rakesh Guduru - Applied Resesarch Center, Florida International University

Xiangyang Zhou, *Ph.D.* – Dept. of Mechanical & Aerospace Engineering, University of Miami
Zedong Wang - Dept. of Mechanical & Aerospace Engineering, University of Miami

ABSTRACT

Contamination and moisture detection are among the most critical issues in preparation of adhesive bonds between composite adherends for the construction and repair of structural composite components. Additionally, understanding how the contamination affects both short-term and long-term bond durability is critical to the development of a quality management system. In this paper, an all solid-state electrochemical sensor and chemical force microscopy (CFM) are used to differentiate variations in functional groups and electrochemical activity on composite surfaces prepared with nylon and polyester peel-plies. Results from these techniques will also be presented on samples provided by Bombardier and Boeing identifying variations from pre-determined contamination and different fiber-matrix and peel-ply configurations. The technical approach obtaining adhesion for measurements using CFM has been improved by utilizing a force volume method in addition to conducting analyses in an environmental chamber to reduce capillary effects. Additionally, mediators in the electrochemical sensor have been improved to increase sensor durability and sensitivity to a wider range of contaminations. Results demonstrate that the electrochemical sensor can detect a wide range of surface contaminants and CFM has the potential to discriminate contaminants based on the surface activity.

This paper also presents the development of a new task related to the evaluation of bond durability performance when undesirable bonding conditions have been imposed. A literature review of past work related to bond durability will be presented, which includes experimental test methods that have shown potential in the study of bond degradation. Particular interest is devoted to those methods where cyclic loading and harsh environmental conditions are imposed to the adhesive bonds simultaneously. A test matrix for both initial bond strength characterization and long-term durability will be developed that includes relevant contaminants, contamination levels, loading conditions and test environments. Finally, preliminary experimental results obtained using the selected approach will be presented.