



Department of Industrial Engineering

***Ph.D. Course in Chemical Engineering
(X Cycle-New Series)
(a.y. 2011-2012)***

Advanced polymeric composites for self-healing structural materials

Supervisor

Prof.ssa Liberata Guadagno

Ph.D. student

Raffaele Corvino

Scientific Referees

Prof. Pasquale Longo

Ing. Augusto Albolino

Ing. Salvatore Russo

Ing. Fiorenzo Lenzi

Ph.D. Course Coordinator

Prof. Ing. Paolo Ciambelli

Abstract

This research work rises from collaborative activities between Alenia Aeronautica (Pomigliano D'Arco, Napoli) and the Industrial Engineering Department of University of Salerno.

One of the biggest challenge facing materials scientists is the idea to put in action self-healing composites in aeronautical applications. Polymeric composite materials, recently introduced in aeronautics, are subject to weakening due to mechanical, chemical, thermal, stress.

This could lead to the formation of microcracks deep within the structure where detection and external intervention are difficult or impossible. The presence of the microcracks in the polymer matrix can affect both the fiber and matrix dominated properties of a composite. In the case of a transport vehicle, the propagation of microcracks may compromise the structural integrity of the polymeric components, and so threatening passengers' safety.

In this work, we have developed a multifunctional autonomically healing composite with a self-healing functionality active at the severe operational conditions of aircrafts (temperature range: -50 °C/80 °C). The self-repair function in this new self-healing system, inspired by the design of White et al., is based on the metathesis polymerization of ENB (or ENB/DCPD blend) activated by Hoveyda-Grubbs'1st generation catalyst. The self-healing epoxy mixture, containing Hoveyda-Grubbs'1st generation catalyst, allows a cure temperature up to 180 °C without becoming deactivated. A quantitative assessment of self-healing functionality showed very high values of self-healing efficiency. Before reaching these amazing results several systems were investigated that differ for the nature and the composition of the epoxy matrix, catalysts and active monomers used: these systems have been gradually improved to suit performance requirements for a structural advanced material to be applied to aeronautical vehicles.