SELF-HEALING FIBER REINFORCED COMPOSITES, BEYOND THE CLEVER CONCEPTS?

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ABSTRACT

Composite materials are man-made combinations of several different materials that produce a new material with unique properties, such as improved stiffness and tailored thermal or electrical conductivity. A large part of these materials combine stiffness and light weight, in particular those designed for transport applications. However, many of these materials, in particular based on thermoset matrices, are rather sensitive to damage, that may occur early, sometimes already from process-induced stresses. A recent development path for composites has been to introduce design concepts inspired from nature, that contribute to change the design from “damage prevention” to “damage management”: by introducing an autonomous self-healing ability to man-made materials, it becomes possible to extend their life-time above a certain design value, even if the initial material property is slightly reduced.

In this respect, self-healing composites are a dream for many structural engineers, as one wish that a structure could behave like a biological element that has the ability to detect damage and fix it to a certain extent, by continuously adapting to the changing environment, or by carrying repair fluids to the damaged zone. Due to the presence of reinforcement fibers, the mechanisms of damage in a composite are complex and take place at various scales. The healing system must be designed to act where needed, without further disrupting the structural integrity of the part. As a result, self-healing fiber reinforced composites have been demonstrated to a lesser extent compared to self-healing polymers, and they still pose technical and scientific challenges to reach maturity, and to move from basic laboratory concepts on model systems to practical applications.

The presentation will review current approaches to develop self-healing composites, and attempt to quantify and open to discussion the critical hurdles, from scientific to technical to economical aspects, that should be overcome to bring these materials closer to market applications.