Towards self-healing polymers for aerospace applications: experimental tools to evaluate healing capability

Antonio Mattia Grande
Department of Aerospace Science and Technology, Politecnico di Milano, via La Masa 34, 20156, Milano, Italy
antoniomattia.grande@polimi.it

Self-healing functionality in materials is an attractive characteristic for aerospace applications. Over the last few years, a number of promising strategies and approaches to develop polymers with healing capabilities have been proposed. A thorough understanding of the healing phenomena is then required for the further development and application of self-healing polymers in advanced engineering fields, such as aerospace industry.
To date, there is no generally accepted method for evaluation of healing efficiency and most researchers have used the recovery of tensile strength of broken samples as the measure of healing in polymers. Despite it being widely used, tensile testing is not the ideal measurement method for the quantification of the self-healing process although it offers a fast first-order approximation. Test protocols based on fracture and damage mechanics can potentially provide more quantitative information on the healing process.
In this talk, fracture and damage mechanics testing procedures are presented and proposed to investigate the healing behaviour of self-healing and healable polymers. Various materials based on different reversible chemistries were tested under different experimental conditions. The obtained results demonstrate how fracture and damage protocols are more suitable to identify the relevant physical and chemical processes across the interface between two former fracture surfaces providing more quantitative information on the healing behaviour respect to the tensile testing procedure. Furthermore, a first comparison of the healing performance is presented highlighting the pros and cons of the studied polymers.