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Development of a measuring system for on-line in situ monitoring of composite materials manufacturing

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Abstract

A unique portable measuring system using an impedance spectroscopy method with a self-adapting frequency of measurement is introduced. The system is intended for the on-line in situ monitoring of composite materials curing under industrial conditions. The capabilities of the developed system are demonstrated through the results obtained from on-line in situ measurements of unreinforced thermosetting resin, as well as of composites under real manufacturing conditions. Observations are supported by the results of other established methods for determining the degree of curing: temperature-modulated differential scanning calorimetry (MDSC), Fourier transform infrared spectroscopy (FT-IR) and broadband dielectric spectroscopy (BDS). Compressive and bending tests were also carried out on manufactured composites removed at different stages of the post-curing phase. Due to the self-adapting frequency, the system has enhanced sensitivity in the post-cure phase when the diffusion-controlled reactions proceed and, therefore, is suitable also for the analysis of hard post-cure samples.

Key words:

A. Polymer-matrix composites (PMCs); B. Cure behaviour; D. Process monitoring, E. Braiding

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