Chemical Monitoring of Composite Matrices by Evanescent Wave Spectroscopy

P.B.S. Bailey, S.A. Hayes, R.J. Hand, B. Zhang

Department of Engineering Materials, University of Sheffield, Mappin Street, Sheffield, S1 3JD, UK.

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ABSTRACT

This paper presents the results of an initial investigation into the potential for monitoring water absorption and chemical degradation in epoxy matrix composites using evanescent wave spectroscopy.

While conventional silica glasses have too low a refractive index and too short an IR transmission window to be useful as unclad sensing elements in most resin systems, chalcogenide glasses offer suitable refractive index and infrared transmission window. Several chalcogenide compositions have been investigated, by embedding fibres in representative matrix resins. Samples of epoxy resin were cast around sections of fibre, the end faces polished to allow an infrared beam to be passed along the fibre. These samples were subjected to hygrothermal aging and the change in transmitted spectra observed, while the photoelastic effect in the resin was used to monitor the occurrence of fibre fragmentation.

Fibre sensing with arsenic selenide compositions with gallium or tellurium has been successfully demonstrated in other applications. Here they present a number of issues, most significantly they exhibited such minimal bonding to the epoxy resin that matrix changes of interest caused loss of signal due to interface separation. Alternative fibres were fabricated from germanium-antimony-lead sulphide glass, with the aim of improving on both fibre adhesion and glass transition. This paper presents test results for this glass composition and discusses the potential for application as an embedded sensing element in fibre reinforced composites.