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THE ELECTRIC FIELD ALIGNMENT OF SHORT CARBON FIBRES TO ENHANCE THE TOUGHNESS OF EPOXY COMPOSITES

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ABSTRACT

An investigation is presented on increasing the fracture toughness of epoxy/short carbon fibre (SCF) composites by alignment of SCFs using an externally applied alternating current (AC) electric field. Firstly, the effects of SCF length, SCF content and AC electric field strength on the rotation of the SCFs suspended in liquid (i.e. uncured) epoxy resin are investigated. Secondly, it is shown the mode I fracture toughness of the cured epoxy composites increases with the weight fraction of SCFs up to a limiting value (5 wt.%). Thirdly, the toughening effect is greater when the SCFs are aligned in the composite normal to the direction of crack growth. The SCFs increases the fracture toughness by inducing multiple intrinsic and extrinsic toughening mechanisms, which are identified. Based on the identified toughening mechanisms, an analytical model is proposed to predict the enhancement to the fracture toughness due to AC electric field alignment of the SCFs.

Keywords: A: Discontinuous reinforcement; B: Fracture toughness; C: Short carbon fibres; D: Epoxy polymer