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Finite element and experimental studies on mechanical behaviour of carbon nanotube reinforced adhesively bonded composite joints

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The studies on nanotube reinforced adhesively bonded joints in aircraft structures are very limited and pose a great challenge. In the present investigation, finite element and experimental studies have been carried out on composite joints bonded with epoxy adhesive and CNT reinforced epoxy adhesive. Two sets of joint specimens, one bonded with Araldite (Araldite 403) epoxy adhesive and another bonded with carbon CNT reinforced Araldite adhesive using 5% by weight of multi wall CNTs (MWCNTs) have been considered. First, experiments are conducted on such joints under monotonically increasing static tensile load until failure. The load-displacement curves and failure loads are obtained for such joints. Then geometrically nonlinear finite element analyses on such joints have been conducted assuming an elastic modulus for the Araldite adhesive material and numerical load-displacement curves have been obtained. The load-displacement results obtained from both experiments and analyses have been compared by repeating the FE simulation iteratively by varying the tensile elastic modulus until they match each other for a corrected value of elastic modulus. Thus, the elastic modulus of Araldite epoxy adhesive has been obtained in an inverse manner. Then the tensile stress-strain curves of CNT reinforced Araldite epoxy adhesive have been derived using a mean field homogenisation approach. The parametric studies on stress-strain response of CNT reinforced epoxy are conducted by varying the percentage, aspect ratio and orientation of the MWCNTs in araldite adhesive and the mechanical behaviour of the joints is studied. The results of mechanical behaviour in terms of stiffness, static strength and stress distribution along bond length of the joints are presented and discussed. This study is important in assessing the structural integrity of CNT reinforced adhesively bonded joints and their possible use in modern composite aircraft.

Biography

P. K. Sahoo obtained his Ph.D. in Engineering from the Department of Aerospace Engineering at Indian Institute of Science (IISc), Bangalore, India. He is employed as a Senior Scientist at CSIR-National Aerospace Laboratories (CSIR-NAL), Bangalore, India and currently, deputed to work as CSIR Raman Research Fellow at IMWF, University of Stuttgart, Germany (September 3, 2012-March 2, 2013). He has published more than 20 papers in reputed journals and conferences.

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