Laser-based surface patterning of composite plates for improved secondary adhesive bonding

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PII: S1359-835X(18)30092-7
DOI: https://doi.org/10.1016/j.compositesa.2018.02.041
Reference: JCOMA 4955

To appear in: *Composites: Part A*

Received Date: 1 November 2017
Accepted Date: 27 February 2018

Please cite this article as: Tao, R., Alfano, M., Lubineau, G., Laser-based surface patterning of composite plates for improved secondary adhesive bonding, *Composites: Part A* (2018), doi: https://doi.org/10.1016/j.compositesa.2018.02.041

Laser-based surface patterning of composite plates for improved secondary adhesive bonding

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Abstract

The effects of laser irradiation surface pretreatments on the mode I fracture toughness of adhesively bonded composite joints were evaluated. First, pulsed CO_2 laser irradiation was uniformly deployed on carbon fiber reinforced polymer (CFRP) substrates. Next, double cantilever beam (DCB) tests were performed to assess the effects of surface pretreatments on the mode I fracture toughness of the adhesive joints. Then, a thoughtful combination of the proposed surface pretreatments was deployed to fabricate DCB specimens with patterned interfaces. A wide range of techniques, including X-ray photoelectron spectroscopy (XPS), contact profilometry, and optical and scanning electron microscopy (SEM) were used to ascertain the effects of all investigated surface pretreatments. It is shown that patterning promoted damage mechanisms that were not observed in the uniformly treated interfaces, resulting in an effective fracture toughness well above that predicted by a classical rule of mixture.

Keywords: Adhesive joints, CFRP, Fracture toughness, Pulsed laser irradiation, Patterned interface

2010 MSC: 00-01, 99-00

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