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Short-aramid-fiber toughening of epoxy adhesive joint between carbon fiber composites and metal substrates with different surface morphology

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Abstract: Carbon-fiber epoxy composites were bonded to four different types of aluminum substrates with different surface roughness and finish. The four aluminum substrates considered in this study have the following surface conditions: two solid aluminum substrates polished with two different grades of sandpapers, and two porous aluminum foams with two different as-received surface conditions, one with a patterned surface finish and one with rough pore structures. Moreover, the thin epoxy adhesive joints between the carbon-fiber face sheets and aluminum substrates were reinforced by adding short aramid fibers. During the fabrication process of the hybrid laminar, sparsely-distributed short aramid fibers were inserted between the fiber-metal interface to promote bridged fibers for tougher and stronger adhesive bonding, while at the same time to minimize any significant change in the thickness of the adhesive joint. Measurements of the critical energy release rate showed that the toughening effects of the low-density short aramid fibers were influenced by the metal-substrate surface roughness and finish. Further comparison indicated that the interfacial fracture toughness of aramid-fiber interleave adhesive joints increased via increase of surface roughness of metal substrates. The surface-roughness effect of metal substrate mainly depends on whether the free fiber ends of the short aramid fibers were pressed and embedded into the surface cavities of aluminum substrates according to scanning

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