

Fracture toughness test of epoxy adhesive dissimilar joint with various adhesive thicknesses

Abstract

In this study, effect of bond thickness upon the strength and fracture toughness of epoxy adhesive dissimilar joint is investigated. Tensile and three-point-bending (abbreviated as 3PB hereafter) fracture tests are conducted. Finite element method (abbreviated as FEM hereafter) analysis is also executed to analyze the stress distribution at an interface corner of dissimilar joint. From FEM analysis results, it is found that the stress singularity in the dissimilar joint exists pronouncedly at the SUS304/adhesive interface corner and the order of stress singularity in the tensile model is higher than that in the 3PB model. Moreover, the order of stress singularity in the dissimilar joint having bond thickness of 1.0 mm is quite identical to the value obtained from analytical solution under the plane stress condition. From 3PB test and tensile test, it has been confirmed that the failure stress of dissimilar joint slightly increases with the decreasing bond thickness and can be well predicted by using the interface corner toughness, H_c parameter. The failure of dissimilar joints always originates from the SUS304/adhesive interface corner and the failure stress for dissimilar joint of 3PB test is higher than that of tensile test. For the specimens failed at the ALU/adhesive interface corner, the poor wettability of ALU adherend's surface plays an important role. For the dissimilar joint with an interfacial crack, the fracture toughness, J_c is calculated by J integral method in FEM analysis. Fracture toughness, J_c for cohesively fractured specimens is more or less constant but shows some dependency on bond thickness for interfacially fractured specimens. Locus of fracture can be best interpreted in terms of stress singularity order at the interfacial crack tip.

Keywords — Adhesive joint, tensile, three-point-bending, stress singularity, joint strength, fracture toughness, interface fracture, cohesive fracture