Brittle fracture validation through crystallographic deformation for the characterization of cleavage in carbon steel

Abstract

This study describes the necessary steps to perform a valid fracture test for the characterization of cleavage in carbon steel. The testing is based on the methodology published in the ASTM Standard, coded E-399-90, by using the compact tension geometry. Predominant elastic fracture or plane-strain fracture toughness KIC is designed in this particular test geometry for the classification of suitable materials. Micrographic analysis of pre-cracking stage by fatigue to cleavage crack initiation and gross plasticity of fracture surfaces are investigated. Validation of elastic or brittle fracture by cleavage of carbon steel has been identified through the characterization using scanning electron microscopic fractography observation. Unique microstructure pertaining to brittle and cleavage failure characteristic has been observed through river patterns and feather marks on the crack initiation zone surface.