Cracks, microcracks, and fracture toughness of polymer composites: formation, testing method, nondestructive detection, and modifications

ABSTRACT

Polymer matrix composite consists of polymeric matrix and fiber as reinforcement. The properties of the matrices and fibers are usually opposite to each other. Where the matrix is soft, the fibers are rigid. This is how they complement each other since the main purpose of the rigid fiber addition was to increase the strength of the soft polymer matrix. However, because of these differences, the microcrack and crack formation and propagation in polymer composite become a complicated topic to be studied since it involves the interaction between the different type of materials. Example of factors that influence the formation of cracks as discussed in the chapter were type and dimensions of the fiber material used, compatibility between the matrix and fiber material, manufacturing process methodology, and application environment. After the cracks or microcracks formed, the next step is the propagation of the cracks. This progress was also influenced by these parameters and the type of composite configuration. The objective of this chapter is to review the different effects of the factors that influence the formation and propagation of cracks and microcracks in polymer composite. Following the discussion about the formation of microcracks, a step-by step method on how to detect and measure the cracks and microcracks, fracture mechanics, and the nondestructive testing available related to it is discussed in detail. Finally, based on knowledge of composite materials, two methods that have been studied and show promising results to improve fracture toughness in polymer composite material.

Keywords: Crack propagation; Fracture toughness; Microcracks; Polymer composite;

Polymer matrix