DETECTION OF MICRO CRACKING AND SIC FIBER DISTRIBUTION AND ITS RELATIONSHIP BETWEEN DARK-FIELD IMAGES USING TALBOT-LAU INTERFEROMETER

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Continuous fiber-reinforced ceramic matrix composites (CMCs) designed high as damage tolerant materials is currently being developed and applied for high temperature structural applications such as hot section components in the aero engines. The microstructure of CMCs is designed as 2D and 3D fiber orientation processes. The fracture behavior of CMCs originates from micro damage evolution such as matrix micro cracking and interface debonding between fiber and matrix, making it inherently dependent on fiber orientation and distribution and shape and distribution of internal defects. Nondestructive evaluation is needed to detect such the defects and micro cracking. It is challenging subject to detect micro cracking, and fiber orientation and distribution using conventional X-ray imaging because of substantially the same absorption coefficient between fiber and matrix.

In the last decade, Talbot-Lau interferometer (TLI) was developed to detect the micro cracking formation and fiber distribution based on grating phase contrast imaging. Three characteristic images can be taken in one shot, called attenuation contrast (AC), differential phase contrast (DPC), and dark-field contrast (DFC) provided information by small-angle scattering. In the case of DFC, possible imaging allows fiber distribution and micro cracking, related to variation of electron density in CMCs. However, the detection limits of micro cracking and SiC fiber orientation and distribution is not fully clarified experimentally.

In this study, micro cracking was induced by indentation and impact test in brittle material for detecting the crack resolution. The crack opening displacement (COD) and DFC imaging was investigated along the cracks originated from the crack origin. The relation between SiC fiber distribution and dark-field images was also investigated by preparing the different volume fraction of the fiber. The effectiveness of volume fraction of the fiber and micro cracking in CMCs was evaluated using TLI at low magnification imaging.

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