MICRO-SCALE OBSERVATION OF CRACKING IN SIC/BN/SIC CERAMIC MATRIX COMPOSITES

Kaitlin Detwiler, Air Force Research Laboratory, USA
kaitlin.detwiler.4@us.af.mil
Reece Hunt, University of Dayton Research Institute, USA
Elizabeth Opila, University of Virginia, USA

Key Words: ceramic matrix composites, micro-scale testing

SiC/BN/SiC ceramic matrix composites (CMCs) will be exposed to both mechanical loads and oxidants during high-temperature service conditions. Stresses may cause micro-cracking in the CMC, allowing pathways for oxidant ingress into the CMC. The surface crack opening displacement (COD) is a key variable in predicting the CMC oxidation and lifetime behavior [1]. In order to supplement CMC oxidation damage modeling, experimental measurements of CODs are required. A tensile stage was used with light and scanning electron microscopy (SEM) to evaluate micro-cracking under tensile load in a SiC/BN/SiC CMC. The SiC/BN/SiC was provided by Rolls-Royce and consists of Hi-Nicalon fibers, a BN interphase, a CVI layer, and SiC particles plus melt infiltrated silicon. Micro-crack spacing and crack composition, a novel measurement introduced in this work, were measured from light microscopy images taken at room temperature. Crack spacing decreased with increasing load, with a majority of cracks in contact with BN fiber coatings. COD was measured at room and elevated temperature (600ºC). An example of increasing COD with load at 600°C is imaged in Figure 1. CODs increased nearly linearly with increased load. CODs were also related to local microstructure, with CODs being wider in the melt-infiltrated matrix material than in transverse fiber tows. The results of this study will be compared to micro-crack spacing models and will also be discussed in context of CMC oxidation mechanisms and models.

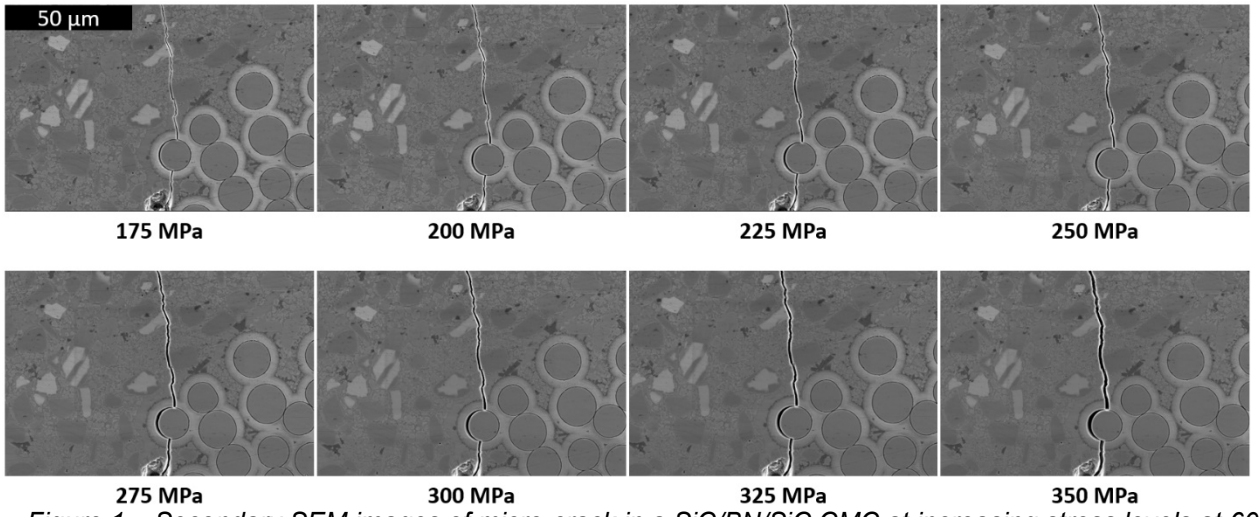

Figure 1 – Secondary SEM images of micro-crack in a SiC/BN/SiC CMC at increasing stress levels at 600°C showing increasing COD with applied load. Loading direction is horizontal.

References

[1] Parthasarathy, T. A., Cox, B., Sudre, O., Przybyla, C., & Cinibulk, M. K. (2018). Modeling environmentally induced property degradation of SiC/BN/SiC ceramic matrix composites. *Journal of the American Ceramic Society*, *101*(3), 973-997.