MICRO-MECHANICAL TESTING OF CERAMIC MATRIX COMPOSITES; EXTRACTION OF CRITICAL INTERFACE PROPERTIES AND IMPACT ON COMPOSITE OPTIMIZATION.

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Ceramic matrix composites have gained significant attention for improving strength and efficiency of high temperature components in the aerospace and nuclear industries. A critical step for this technology is the development of models that capture macroscopic failure behavior and probability based on constituent-level characteristics. This research presents the applicability of small-scale mechanical testing to probe relevant interface properties in the context of composite toughening mechanisms. An experimental case study applying micro-pillar compression for interfacial shear strength is presented. The test scope compares property data for two fiber types, HNLS and SA3, across varying pyrolytic carbon interface thickness (50-1000nm). The Mohr-Coulomb friction criterion was applied to extract the cohesive debond shear strength and internal friction coefficient, shown in figure 1(left). Experimental results showed a non-linear trend as a function of increasing normal load. These results were further characterized with FEM to develop a modified criterion that corrects for boundary conditions and helps separate property dependencies on roughness, thickness, and normal stress. These properties are discussed and used to inform analytical models that traditionally back-calculate a blanket parameter, τ, based on uniform crack spacing shown in figure 1 (right). Finally, novel techniques and preliminary results to characterize dynamic friction and wear *in operando* are discussed.

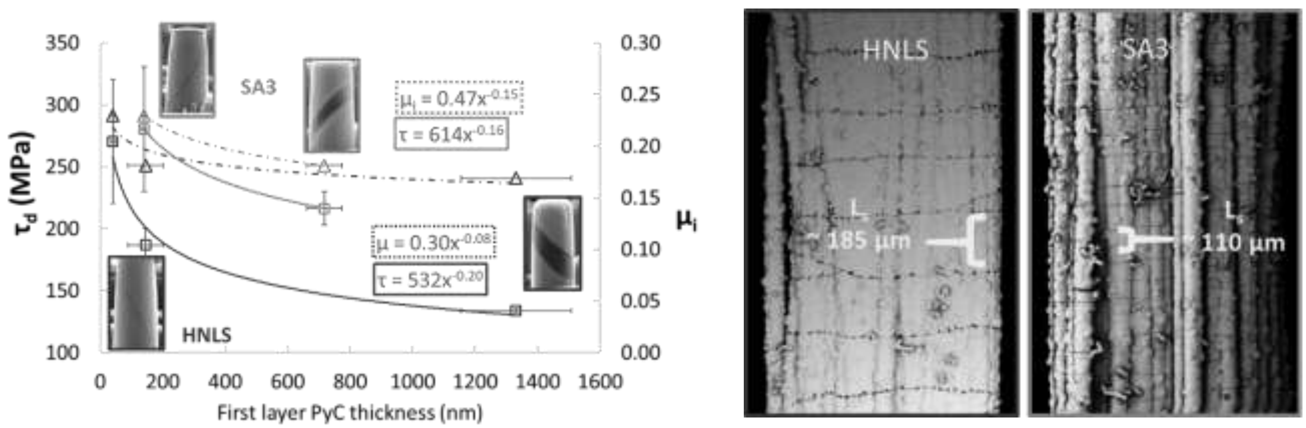

Figure 1 – (Left) Interface property values plotted as a function of interface thickness and fiber type. (Right) In Situ SEM images of macroscopic damage evolution during mini-composites tensile testing. The identified micro-crack spacing is characteristic of interface properties identified by micro-pillar compression.