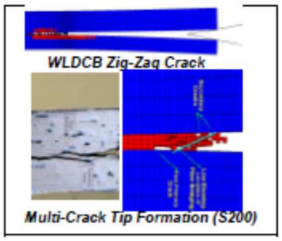
CMC コンソーシアム会員の皆様

第 12 回 CMC コンソーシアムセミナーを下記のように開催いたします。

講演者　　：Dr. Frank Abdi、AlphaSTAR

講演タイトル　：Development of ASTM Test Standards for the Mode I-II Interlaminar Fracture Toughness (G_{Ic}--Crack Growth Resistance) of Ceramic Matrix Composites at RT/ET

ABSTRACT



Ceramic matrix composite (CMC) materials are targeted for high temperature applications in aircraft and power turbines because of their low density and high-temperature thermo-mechanical properties, compared to conventional nickel super alloys. Advanced Integrated Computational Material Engineering (ICME) has been able to predict variety of CMC industry application challenges, namely: 1) Virtual Manufacturing, Plasma spray coating, rumpling, thermal growth oxidation (TGO); and 2) Virtual Testing, Environmental degradation, Foreign object damage (FOD), Erosion, Creep, fatigue, retained strength, and Crack Growth Resistance (CGR).

New test methods are needed for assessment of effects of delamination cracks on the structural integrity and life of CMC components. The ASTM C28 Fracture Toughness- CGR Working Group has drafted a standard test method for the “Mode I -II Interlaminar Fracture Toughness (G_{Ic} -- CGR) of Fiber-Reinforced CMC. The ASTM test standard details the scope, use, and application of the test method, interferences, test equipment, specimen geometry and preparation, test procedures, data interpretation and calculation, and reporting requirements for the new CMC CGR test method.

The emerging CMC materials require addressing the ASTM test standards for CMCs’ CGR concerns, eventual qualification under service loading: Highlights in testing and modeling of CGR and derivation of simple beam equation can be summarized as: 1) Zigzag (wavy) crack path pattern and fiber bridging, 2) Samples are very thin and difficult to machine and test; 3) Specimen initial crack, width and thickness may contribute to mixed mode failure evolution; 4) correct measurement of interlaminar CGR and determination of critical fracture energy *GI* by test or modeling; 5) Modeling to consider: (i) test observed wavy crack growth pattern due to woven architecture and/or shift in failure mode, This effort combines the test method, modeling, and Data Interpretation.

Mode I-II interlaminar fracture toughness specimens may exhibit interaction and zig-zag crack growth behavior. CGR, ICME, and De-homogenized (fiber, matrix, interphase) Multi Scale Progressive Failure Analysis (DE-MS-PFA) based solution for CMC materials was developed which included design and test of standard test methods for: (i) Mode I Double Cantilever Beam (DCB), Wedge Loaded DCB (WDCB); and (ii) Mode II End Notched Flexure (ENF) and End-Loaded Split (ELS). ICME predictive methodology also used a new proposed ASTM standard simplified CGR compliance equation to correlate the wedge load vs crack opening to *GI* considering geometrical anomalies and initial crack. Mode II was characterized by ENF/ELS tests where rising R-curve behaviors were observed signifying increased toughness/resistance to crack growth. Design of Experiment (DOE) methods were used to optimize ELS geometry and initial crack length while minimizing the contribution of interlaminar tension (ILT) and maximizing interlaminar shear (ILS).

Prediction vs. Test Validation of an S200 Nicalon/SiNC and Oxide/Oxide Ceramic Matrix Composite (CMC) was conducted to determine the crack growth resistance (GIc) of Mode I WDCB and Mode II ENF at Room and Elevated temperatures (RT/ET) and compared with experimental tests observations. In addition, DOE optimization determined design of specimen length, width, and initial crack length for WDCB and ENF specimens. Note: The wedge loading method was developed to avoid the problems of high temperature bonding of loading blocks and hinges. Wedge Loading gives proper crack path without mixed mode effects and can be used at high temperature in a furnace.

■日　時　　：　2022 年 6 月 29 日（水）8：30－9：30 (予定)
■場　所　　：　オンライン開催(Teams)
■参加資格　　：　CMC コンソーシアム会員限定
■参加費　　：　無料
■申込期間　　：2022 年 6 月 1 日（水）から 6 月 24 日（金）　まで
■お申込み方法
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内容変更や取消の際に必要となりますので保管をお願いいたします。
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■参加申込いただいた方には、
6 月 27 日(月)頃に、返信いただいた e-mail アドレスへ web セミナーのご招待メールをお送りいたします。
多くの皆様のご参加をお待ちしております。

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