DAMAGE MECHANISM OF AN ENVIRONMENTAL BARRIER COATED CERAMIC MATRIX COMPOSITE UNDER THERMAL AND MECHANICAL LOADINGS

Thibaut Archer, ONERA, France
thibaut.archer@onera.fr
Ines Hamadouche, ONERA, France
Pierre Beauchêne, ONERA, France
Thomas Vandellos, Safran Ceramics, France
François Hild, Laboratoire de Mécanique Paris-Saclay, France

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In order to be used in the hot sections of future turbine engines, ceramic matrix composites (CMCs), which are currently investigated, require the use of an environmental barrier coating. The presence of water vapor in these applications leads to surface recession of the protective silica layer formed from silicon carbide at high temperatures [1]. Therefore, the durability of CMCs calls for the development of new and reliable environmental barrier coatings (EBCs). Besides physicochemical interactions, coated CMCs undergo hot gas steam and forced air cooling, leading to complex thermomechanical loadings, which include through thickness and surface thermal gradients. Among existing damage mechanisms under such conditions, through thickness cracking of the coating have been shown to be critical for the lifetime of the system [2], more specifically when cracks reach the bond coat. Therefore, understanding the cracking of the coating in challenging environments becomes essential. Depending on the coefficient of thermal expansion, residual stresses can generate mud cracks [2] after stabilization. In this case, the coating is in compression after heat treatment and will crack during cooling if the coating creeps [3] when facing thermal gradients. To study this damage mechanism a high heat flux CO2 laser is used to heat locally the system, generating through thickness and surface thermal gradients. In addition, a 4-point bend test is performed to add mechanical loading (*Figure 1*). To monitor the test, an infrared camera is used to measure temperature fields on the coating surface. Besides, visible light cameras enable for displacement fields measurement using digital image correlation. Under these conditions, the coating is subject to creep and through thickness cracking. The aim of this work is to identify cases where the crack network reaches the bond coat layer, depending on the laser and mechanical loadings and the coating thickness. Finite element simulations are used to understand the observations.

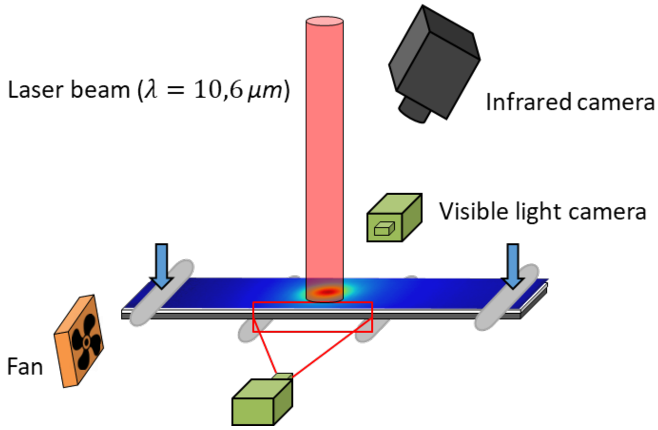

Figure 1 – Schematic view of the 4-point bend test combined with laser heating

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