CRACK MORPHOLOGY IN A COLUMNAR THERMAL BARRIER COATING SYSTEM

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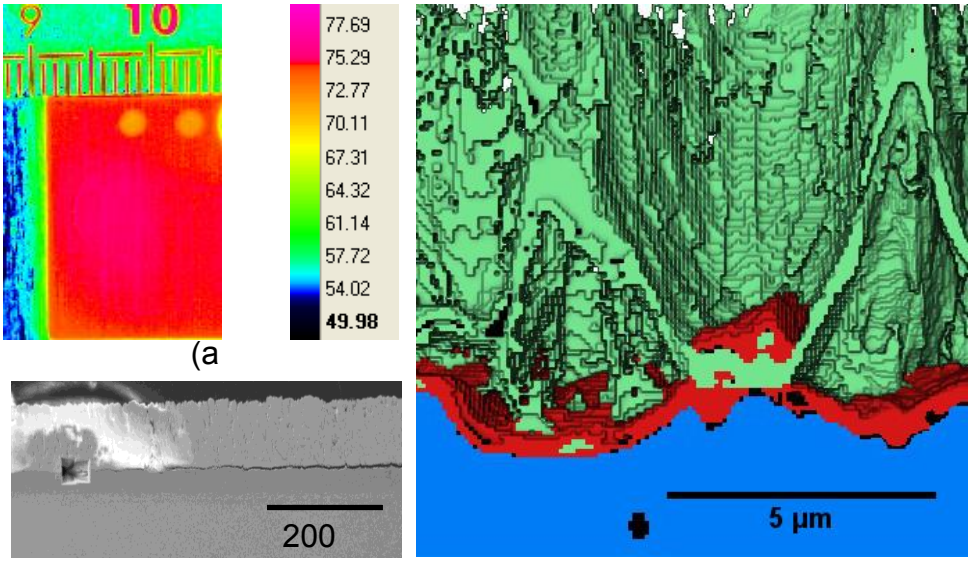
Key Words: LASAT, FIB, EB-PVD, 3D morphology, crack tip

For high temperature application, EB-PVD ceramic layers are commonly used as thermal barrier coating. During thermal transients, the thermal expansion mismatch between coating and substrate drives failure of the TBC mainly by interfacial cracking. Laser Shock Adhesion Test (LASAT) provides stresses at the ceramic/metal interface enabling controlled interfacial cracking [1-2]. For achieving a clear understanding of the influence of local morphology on interfacial toughness, this study aims at characterizing the 3D morphology of a crack at the interface between metal and an EB-PVD TBC having a columnar structure.

Cracks were produced by LASAT. Surface infra red measurement yields to the localisation of the crack, that is detailed using cross-section, Fig (a) and (b) respectively. The crack tip was documented further in SE and BSE image stacks collected simultaneously during subsequent slice and view operations using a focus ion beam (FIB) and a scanning electron microscope (FIB slice & view). The segmented 3D data gives clear understanding of the columnar structure of the ceramic and of the interaction between the crack and the TBC microstructure, Fig (c).



(a) IR analysis: yellow spots evidence interfacial crack
(b) SEM cross-section: square on left side corresponds to the FIB location at the crack tip
(c) Segmented images obtained from FIB: bond-coat (blue), oxide layer (red) both voids and cracks (green), ceramic (transparent)

References

[1] Guipont, et al (2010). Journal of Biomedical Materials Research Part A, 95(4), 1096-1104.
[2] Sapardanis, et al (2016). Surface and Coatings Technology, 291, 430-443.