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STRESS AND CRACK MONITORING DURING PLASMA SPRAYING OF TBC

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Two types of process monitoring techniques are compared and discussed in this presentation. The first one is in-situ curvature monitoring, by which it was possible to evaluate the stress evolution during plasma spraying and separately identify the sources of stresses, i.e., the quenching stress and thermal stress as shown in Fig.1 (a). By changing the spraying parameters, it was possible to prepare specimens at largely different deposition temperatures, which resulted in significantly different levels of residual stresses. Also, it was found that the mechanical properties of the obtained YSZ coatings such as the elastic modulus are strongly dependent on the deposition temperature as shown in Fig.1 (b). Four-point bending test was conducted to these coatings, which clearly showed that the compressive residual stress effectively offset the applied tensile stress to initiate cracking in the YSZ coatings.
Another method is based on acoustic emission (AE). Non-contacting laser AE sensors as shown in Fig.2 were used to detect cracking in YSZ coatings during spraying. Due to the intensive noise from the plasma spraying environment, extensive signal processing techniques have been developed to eliminate the noise in the frequency and time domains by using digital filtering and multi-threshold techniques. The obtained results so far indicate that the through thickness temperature gradient during spraying plays a major role in the formation of deep vertically segmentation cracks.

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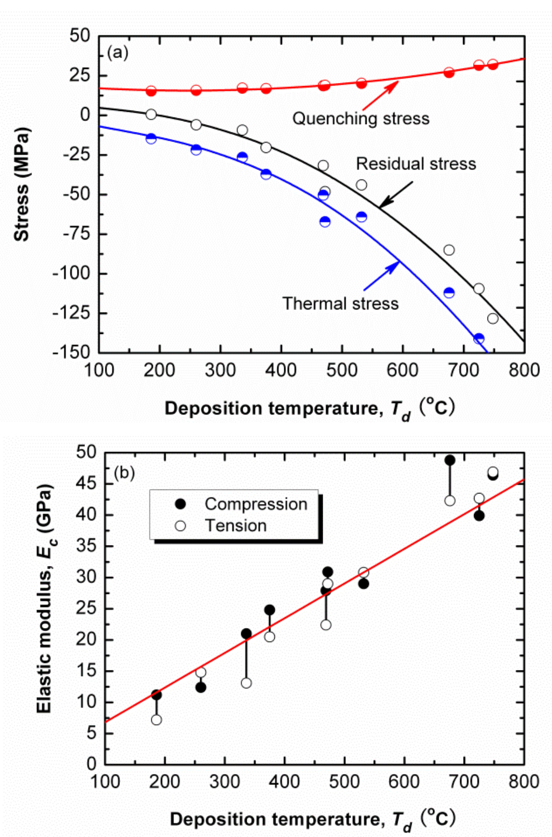

Fig.1 (a) Residual stresses in and (b) elastic modulus of plasma sprayed TBC formed at different deposition temperatures [1,2].

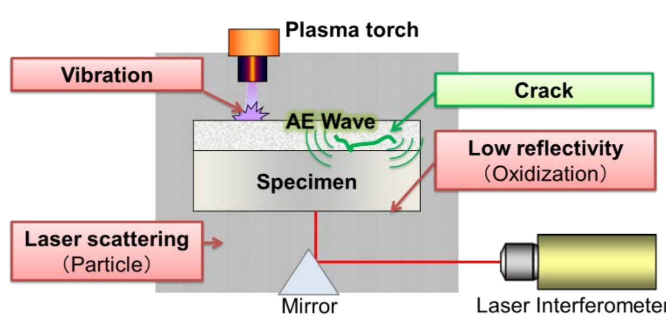

Fig.2 Schematic of laser AE measurement during plasma spraying [3].