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Evaluating Mechanical Properties of CoNiCrAlY Coating from Miniature Specimen Testing at Elevated Temperature

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Abstract : CoNiCrAlY alloys have been widely used as bond coats for thermal barrier coating (TBC) systems because of low cost, improved control of composition, and the feasibility to tailor the coatings microstructures. Coatings are in general very thin structures, and therefore it is impossible to characterize the mechanical responses of the materials via conventional mechanical testing methods. Due to this reason, miniature specimen testing methods, such as the small punch test technique, have been developed. This paper presents some of the recent research in evaluating the mechanical properties of the CoNiCrAlY coatings at room and high temperatures, through the use of small punch testing and the developed miniature specimen tensile testing, applicable to a range of temperature, to investigate the elastic-plastic and creep behavior as well as ductile-brittle transition temperature (DBTT) behavior. An inverse procedure was developed to derive the mechanical properties from such tests for the coating materials. A two-layer specimen test method is also described. The key findings include: 1) the temperature-dependent coating properties can be accurately determined by the miniature tensile testing within a wide range of temperature; 2) consistent DBTTs can be identified by both the SPT and miniature tensile tests (~ 650 °C); and 3) the FE SPT modelling has shown good capability of simulating the early local cracking. In general, the temperature-dependent material behaviors of the CoNiCrAlY coating has been effectively characterized using miniature specimen testing and inverse method.

Keywords : NiCoCrAlY coatings, mechanical properties, DBTT, miniature specimen testing
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