THERMOMECHANICAL DEFORMATION BEHAVIOR AND MECHANISMS IN TRANSITION METAL CARBIDES

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Mechanical testing over 2000ºC is arduous because of the required heating, compliance in components, and potential specimen reactions to name a few. In this talk, the use of a non-contact means of thermomechanical loading, initially demonstrated by Gangireddy and Halloran, is applied to TaC and HfC. By passing a current through the carbide, it is resistively heated and, in the presence of a magnetic field, the specimen bends under the Lorentz force. Using a variety of loads and temperatures up to 3000ºC, the thermomechanical behavior is quantified for a series of tantalum and hafnium carbides. Findings include more deflection in TaC than HfC at equivalent load/temperatures which is contributed to TaC's ease of {111} slip. At failure, TaC exhibited abnormal grain growth with multiple slip band formations on the fractured surface. In contrast, HfC exhibited minimal grain growth and substantially less slip band formations. Additional studies determining the relationship between load at failure as a function of temperature were determined. The collective results will be discussed in terms of TEM and DFT analysis of slip mechanisms in transition metal carbides.

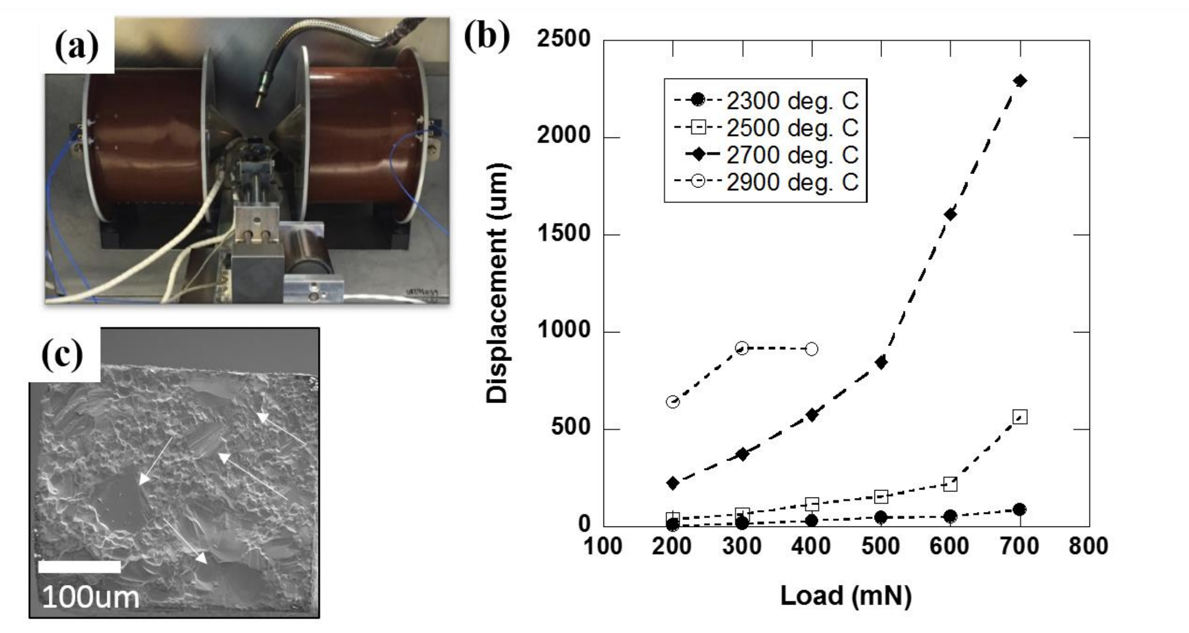

Figure 1: (a) Experimental set up composing of the electromagnetics (b) Representative load vs. displacement curve for TaC at various temperatures (c) Fracture surface of TaC. Note the abnormal grain growth indicated by the white arrows.