OR0502

NANOINDENTATION MEASUREMENTS AT ELEVATED TEMPERATURE FOR THIN COATINGS

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Instrumented Indentation Testing (IIT) has been largely developed to determine the mechanical properties of thin films. Characterization of thin film mechanical properties at elevated temperature represents significant industrial interest in different fields like PVD or thermal barrier coatings.
The major limitations in high temperature measurements have been thermal drift, signal stability (noise) and oxidation on the surface. Thermal drift is a measurement artifact that arises due to thermal expansion/contraction of indenter tip and loading column. This gets superimposed on the mechanical behavior data precluding accurate extraction of mechanical properties of the sample at elevated temperatures [1].
The novel vacuum nanoindentation system designed to perform reliable load-displacement measurements over a wide temperature range (up to 800 °C) will be presented. This system is based on the patented design of the Ultra Nanoindentation Tester (UNHT [2]) that utilizes an active surface referencing technique comprising of two independent axes, one for surface referencing and another for indentation. Vacuum has also become an essential part of the instrument in order to prevent sample/tip oxidation at elevated temperatures. Influences of experimental parameters are explained.
Recent measurements at high temperatures with system characterization and experimental protocol will be presented. Validation by performing extensive testing on calibration materials like fused silica will be shown as well as case studies on coatings and metallic materials.
References
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Keywords
nanoindentation
high temperatures
mechanical properties