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A NEW DESIGNED 1200 °C HIGH TEMPERATURE INSTRUMENTED NANOINDENTATION PROBE TO INVESTIGATE THE MECHANICAL BEHAVIOR OF MATERIALS.

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Abstract

The integrity of thermal barrier coating systems is strongly influenced by the mechanical properties of the different layers constituting them, in particular the metallic bondcoat (NiAl-based or MCrAlY alloy). At high temperature, interdiffusion and oxidation phenomena cause changes in the composition of the bondcoats and as a result their mechanical behaviour is likely to change also.

To determine the mechanical behaviour of such alloys in particular, Onera initially designed and developed a high temperature instrumented microindenter capable of functioning up to 1000°C. In a second time, Michalex has developed his own instrumented nanoindenter using Onera know-how.

Several technological solutions have been implemented to improve the indent positioning (with an accuracy better than 1 µm) and the loads applied (max 20 N) to cover the gap between nano and micro range.

To minimize thermal fluctuations in the testing zone, and to limit oxidation effects a lot of design modifications have been implemented.

Examples of creep behaviour as well as moduli evolution with diffusion effects in various (Ni, Pt)Al alloys are presented and the new design of Michalex apparatus is discussed.

Keywords: thermal barrier coating; instrumented micro nano indentation; high temperature