Fall 10-6-2015

# High temperature indentation creep and nanoindentation testing of superalloys and TiAl alloys

Mathias Goken
*FAU*, goeken@ww.uni-erlangen.de

Markus Kolb
*FAU*

Doris Amberger
*FAU*

Steffen Neumeier
*FAU*

Jeff Wheeler
*EMPA Thun*

***See next page for additional authors***

**Authors**
Mathias Goken, Markus Kolb, Doris Amberger, Steffen Neumeier, Jeff Wheeler, and Johann Michler

# High temperature indentation creep and nanoindentation testing of superalloys and TiAl alloys

Mathias Göken, Markus Kolb, Doris Amberger, Steffen Neumeier, Jeff Wheeler*, Johann Michler*

Friedrich-Alexander-University Erlangen-Nürnberg, FAU; Institute for Materials Science & Engineering I, Erlangen, Germany,

*goeken@ww.uni-erlangen.de*

*EMPA Thun, Switzerland

Measuring of the high temperature mechanical behaviour of materials by local testing has become a key task in the field of nanomechanics. However, gaining access to the application temperature of many metallic high temperature materials, which is in the range of 600°C - 1100°C, is quite difficult. In addition, creep parameters can only be determined by long time measurements, where drift influences become a severe challenge. Here we present a new approach of indentation creep testing with a flat punch indenter. For this, a thermo mechanical analyzer with very precise temperature control is used, which allows testing at temperatures up to 1200°C. A flat punch indenter with a diameter of around 10 µm allows for example local investigations of the creep properties on the dendritic scale of superalloys. This approach is also interesting to study the creep properties along the gradient of diffusion couples. Here, first test measurements on superalloys and other materials are presented and discussed.

For comparison also high temperature nanoindentation measurements will be shown. Such measurements have been conducted on a multiphase titanium aluminide alloy from room temperature up to 600°C. The results show, that the hardness of the (β0+ω0)-composite phase is the highest among all phases and remains constant up to the service temperature.

Both approaches of high temperature testing are compared and the prospect of these methods will be discussed.