ICSMA19 Metz, France, June 26 - July 1, 2022
International Conference on Strength of Materials

Combinatorial Investigation of the Local Creep Properties on Diffusion Couples by Indentation Creep Testing

Lukas Haußmann[a,*], Steffen Neumeier[a], Dorothea Matschkal[a], Markus Kolb[a], Mathias Göken[a]

[a]*Friedrich-Alexander-Universität Erlangen-Nürnberg, Department of Materials Science & Engineering, Institute I: General Materials Properties, Martensstr.5, 91058 Erlangen, Germany*

**corresponding author, e-mail address: lukas.haussmann@fau.de*

Microstructural inhomogeneities and concentration gradients are present in nearly all multi-component materials and are important to optimize the macroscopic mechanical properties. Nanomechanical testing techniques are very well suited to determine the influence of these local differences on the mechanical properties. Indentation creep testing is a convenient technique for investigations of the local creep properties at elevated temperatures and a new approach with a 20 µm cylindrical flat punch has been developed to allow such measurements on the micrometer scale in a thermomechanical analyzer [1].

Using crystal plasticity FEM simulations, conversion parameters were calculated to allow the transformation of the indentation creep data to uniaxial creep data. Furthermore, this indentation creep testing approach has been further developed and supplemented with a 2D-positioning system and the possibility of using a reducing atmosphere to prevent oxidation at high temperatures.

Together with nanoindentation and microstructural analysis this new indentation creep approach was used to conduct combinatorial investigations on a Co-Ni diffusion couple as well as on a more complex diffusion couple consisting of the Co-base superalloy CoWAlloy2 and a derivate of this alloy with an increased Cr-content. It could be shown that this combination of local mechanical testing with the diffusion couple approach has an great potential for alloy development as many alloy compositions can be investigated on one sample.

Keywords: Indentation creep testing, Local mechanical properties, Ni-Alloys, Solid solution hardening, Superalloys

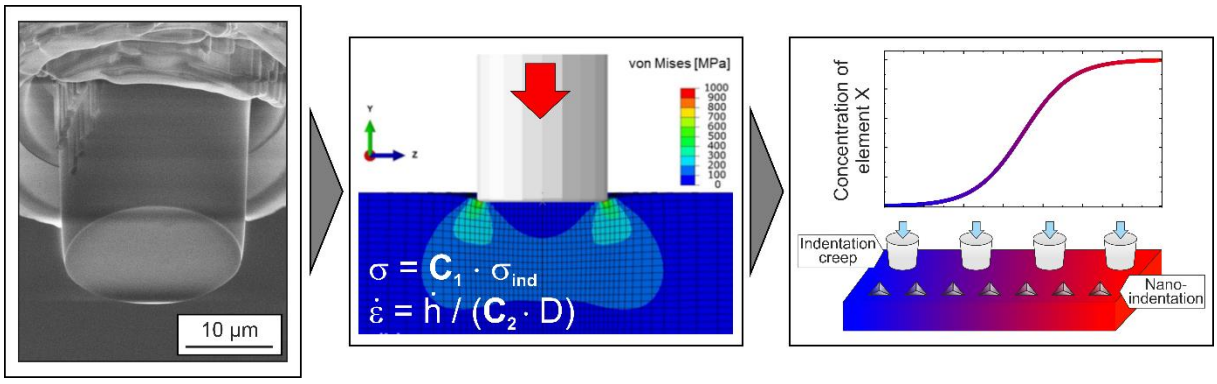

Fig.1: New indentation creep technique with conversion to conventional creep data and application on diffusion couples.

[1] D. Matschkal-Amberger, M. Kolb, S. Neumeier, S. Gao, A. Hartmaier, K. Durst, M. Göken, New flat-punch indentation creep testing approach for characterizing the local creep properties at high temperatures, Materials & Design. 183 (2019) 108090.