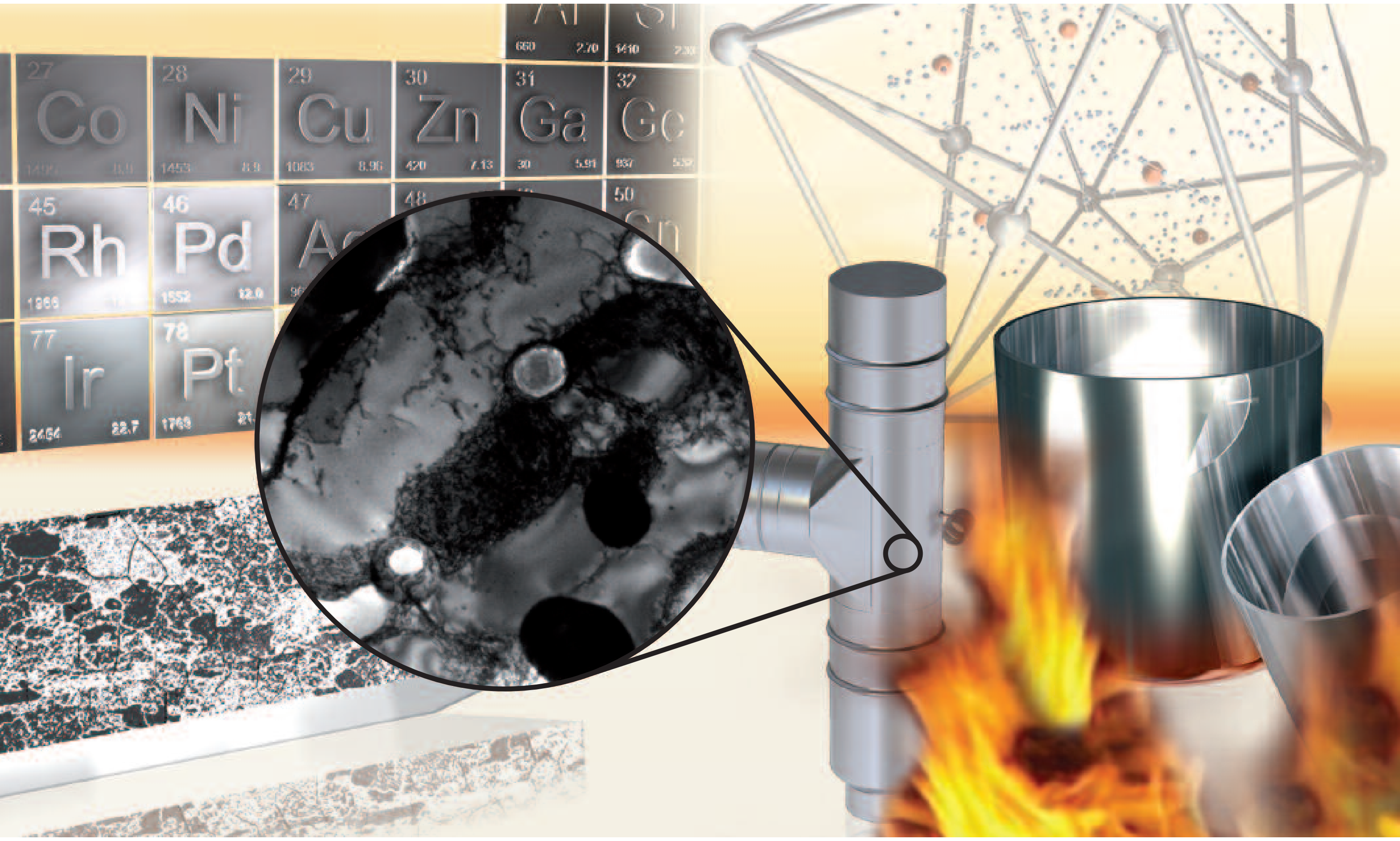
Heraeus



Strengthening Mechanisms in the Pt DPH Materials

An increase in strength is achieved in metallic materials for high temperature applications mainly by reducing the mobility of dislocations and grain boundary sliding.

Besides solid solution hardening, the mobility of dislocations at temperatures over 1200°C, which are typical for the use of Pt DPH materials, is reduced by incoherent oxide particles. The hardening by means of the oxide particles represents the most effective strengthening mechanism.

When a dislocation that is gliding on a slip plane through the matrix interacts with the finely dispersed particles, increased energy is required to overcome these obstacles, resulting in a reduction of the dislocation mobility.

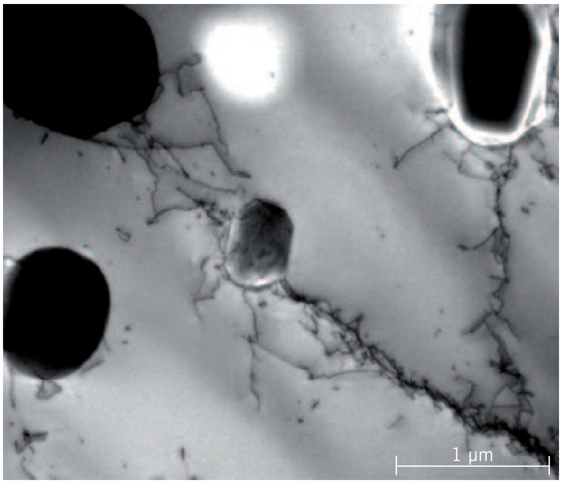
According to the well established Rösler-Arzt model, dispersion hardening is most effective for particles with diameters < 200 nm. In addition to this mechanism, the formation of subgrain boundaries and dislocation networks on larger particles (approx. > 200 nm) was observed in the Pt DPH materials.

These newly observed mechanisms provide at least the same degree of strengthening and also contribute to understanding the high creep ductility of the Pt DPH materials.

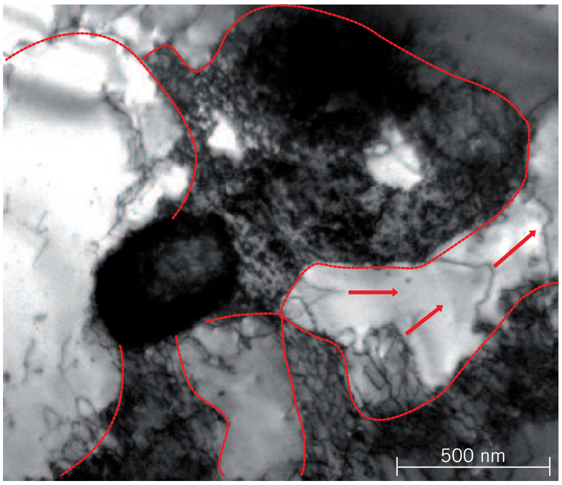
TEM Investigations on Creep-Deformed Pt DPH Materials

In the standard Pt DPH materials, the oxide particles are present at a small volume fraction, finely distributed throughout the matrix. In Pt-5%Rh DPH*hs* the volume fraction has been increased.

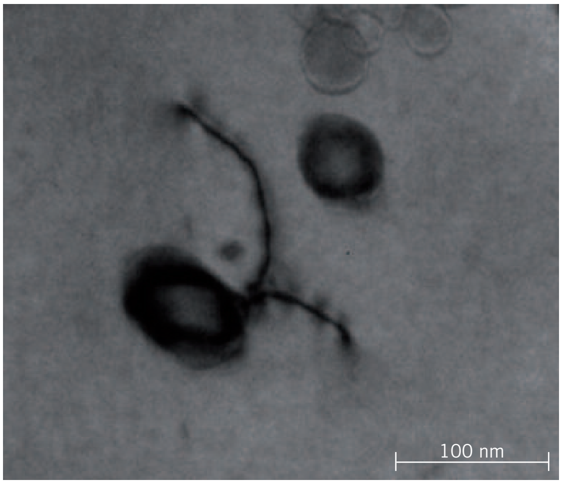
Besides reducing the mobility of dislocations, the oxide particles also provide a mechanical stabilization of the grain boundaries. This prevents grain boundary sliding and grain growth almost completely.



Formation of subgrain boundaries even in the early stages of creep



Dislocation pile-ups and the formation of networks during creep



Interaction of small oxide particles with individual dislocations in accordance with the Rösler-Arzt model[1]

[1]Acta mater., 1998, Vol. 46, No. 16, pp. 5611 – 5626

Dislocation networks observed around larger particles in Pt DPH materials

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