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Lattice parameter misfit evolution during creep of a cobalt-based superalloy single crystal with cuboidal and rafted gamma-prime microstructures.

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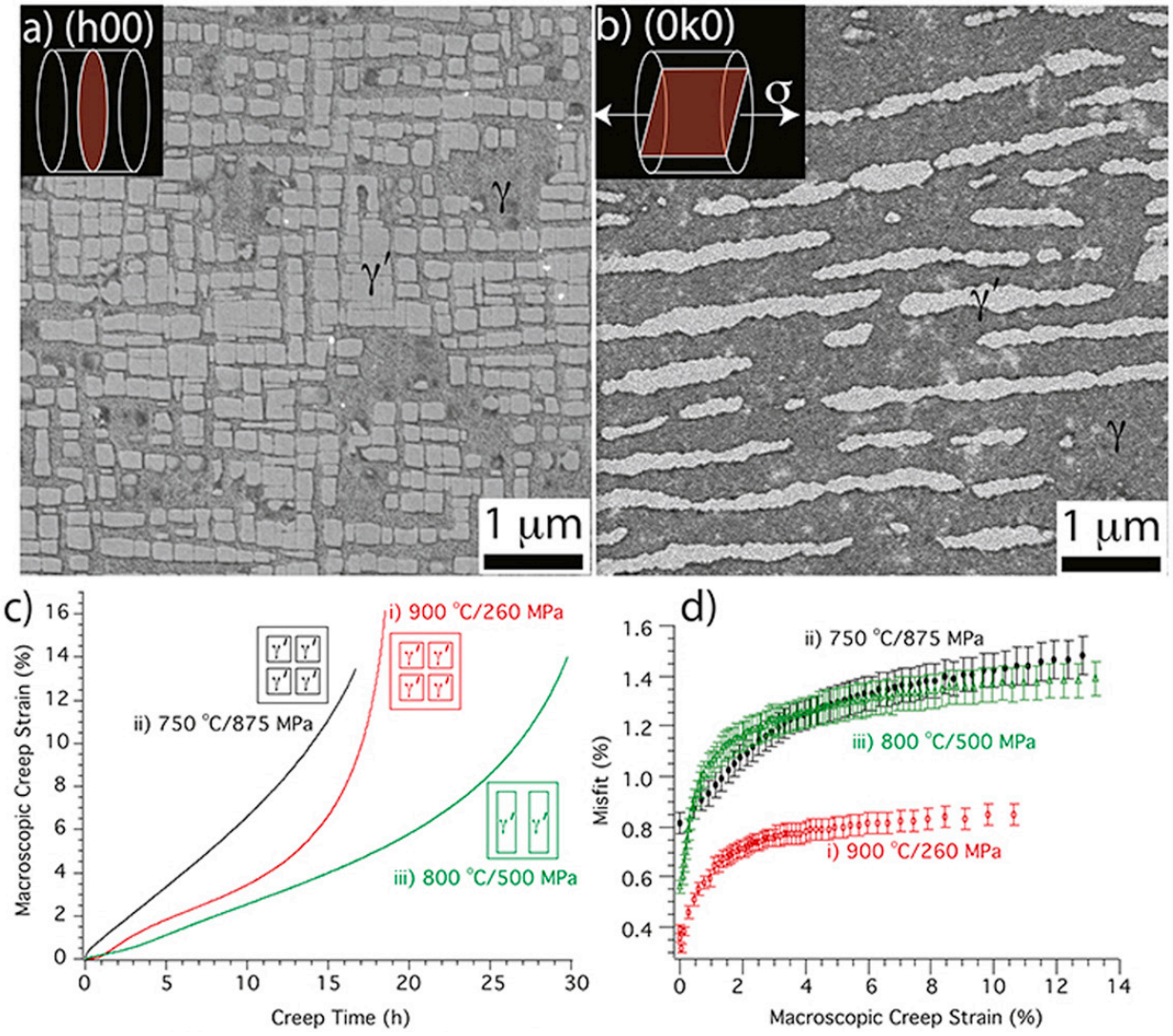

Caption: *Representation (blue isosurfaces) of charge transferred between different molecular building blocks. Calculations were performed with Constrained DFT.*

Scientific Achievement

We compare the creep induced rafting behavior in single crystal multinary Co-based alloy with a small W content (Co-30Ni-7Al-4Ti-2W-3Mo-1Nb-1Ta at%) and Ni-based superalloy (CMSX-4).

It was demonstrated that under a tensile creep, γ′-precipitates raft perpendicular to the applied load in Ni-based superalloys, whereas γ′-precipitates coarsen parallel to the applied load in Co-based superalloys. Neutron-diffraction measurements performed at Oak Ridge National Laboratory demonstrates that creep occurs predominantly in γ-channels in CMSX-4, whereas in the Co-based superalloys, both the γ- and γ′-phases deform during creep.

Significance

The lattice parameter misfit values between the precipitates and the matrix approached their unconstrained values during creep and were notably large compared to those of Ni-based superalloys. This is indicative of a loss of coherency at the precipitate/matrix interfaces. Such a loss of coherency at the precipitate/matrix interfaces will most likely degrade certain mechanical properties, such as fatigue resistance, as has been shown for Ni-based superalloys.

Citation

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