

Seminar of Department 18

Dr. Petr Šittner

FZU - Institute of Physics of the Czech Academy of Sciences

Plastic deformation of B19' martensite by kwinking – where it matters in NiTi technology

Nitinol technology, besides utilizing the functional thermomechanical properties derived from the B2 cubic to B19' monoclinic martensitic transformation, exploits also the excellent plastic deformability of NiTi in martensite state. It originates from the unique mechanism of plastic deformation of the B19' martensite by kwinking involving dislocation slip based kinking assisted by deformation twinning. Although the mechanism of plastic deformation of martensite by kwinking was revealed only very recently, various unusual phenomena that can only be rationalized by kwinking, have been reported in literature since 50 years ago.

These phenomena include: 1) cold working with high degree of reduction without introducing cracks, 2) excellent plastic deformability in martensite state (plastic deformation up to ~80% strain at stresses >1GPa), 3) refinement of austenitic microstructure to quasi-amorphous state by tensile deformation, 4) observation of {114} deformation bands in austenitic microstructures, 5) systematic ruptures of strengthened NiTi wires in tensile tests via necking beyond the onset of plastic yielding, 6) localized plastic deformation in tensile tests via propagation of Luders band fronts with very large localized strain (~40%), 7) unusually long upper stress plateaus in superelastic tensile tests (>8% strain), 8) extreme strain ratchetting in thermal actuation cycling under high stress (> 20 % plastic strain in a single closed loop cooling/heating cycle under constant stress), 9) shape setting of already annealed NiTi.

In the talk, I will introduce the mechanism of kwinking deformation and discuss how the above mentioned phenomena were reinterpreted in view of the recent understanding of plastic deformation of B19' by kwinking.

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