17:20–Function Hall C

Microstructure-dependent mechanical behaviors of SiC nanowires

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The tensile behaviors of [111]-oriented SiC nanowires (NWs) with various microstructures are investigated by using molecular dynamics simulations. The results elucidate the influence of microstructures on brittleness and plasticity of SiC NWs. Plastic deformation is mainly induced by the anti-parallel sliding of 3C grains along an intergranular amorphous film parallel to the (111) plane and inclined at an angle of 19.47° with respect to the NW axis. Also revealed is that the wide dispersion of mechanical properties of SiC NWs observed in experiments is attributed to their diverse microstructures.

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17:40–Function Hall C

An experimental and theoretical study of size effects in the torsion of micro-sized metallic wires

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Both torsion and tensile tests are performed on polycrystalline copper wires with diameters in the range of 20–50 μm. Significant size effects are observed at initial yield and plastic flow stress in torsion, while only a minor size effect presents in tension. The experimental observations are explained in terms of the Fleck–Willis strain gradient plasticity theory. These results confirm that a considerable strain-gradient still exists in the torsion of micro-sized polycrystalline wires, overriding the influence of external geometrical size and grain size.

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SM13: Plasticity, viscoplasticity and creep
13:20–15:40, Monday, 20 August
Frédéric Barlat, Public of Korea, Chair
George Z. Voyiadjis, USA, Chair
Room: 202A+B

13:20–202A+B

On constitutive equations for processes of severe plastic deformation

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The main purpose of processes of severe plastic deformation is to improve material properties. Therefore, the formulation of the equations which govern the evolution of these properties at large strains is an outstanding problem in plasticity theory. This paper concentrates on a general approach to this issue and its specialization to the evolution equation for average grain size. The main idea supported by some experimental data is to include the rate of the rotation of the principal stress axes in the formulation of constitutive equations for describing processes of severe plastic deformation. A set of experiments feasible for practical realization is proposed to reveal a possible effect of include the rate of the rotation of the principal stress axes on the formation of microstructure of material subject to severe plastic deformation.

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13:40–202A+B

Micromechanical modelling of the softening of metallic materials during cyclic and creep loading

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Metals and alloys with initial high dislocation density and small (sub)grain size are generally prone to large softening during cyclic or creep loading. This softening behaviour is characterized by stress amplitude decrease during strain-controlled tests and short stationary stage followed by long tertiary stage showing increasing strain rate during creep. This behaviour is observed whatever the crystallographic structure for various metals and alloys: martensitic steels, bainitic steels and ultrafine-grained polycrystals. Two main mechanisms have been extensively observed and explain partially this softening behaviour: strong decrease in dislocation density and large increase in (sub)grain size mainly due to low-angle boundary (LAB) vanishing). A multiscale model has been developed in the framework of continuum mechanics. Production and annihilation of free dislocations and LAB ones are taken into account. Predicted macroscopic softening and microstructure evolutions are in fair agreement with experimental data obtained for various materials and loading conditions. Predictions are shown to be stable with respect to parameter values.

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