Plasticity and Deformation Mechanisms of Fully Dense Bulk Nanocrystalline fcc and bcc Metals

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Recent results on the fundamentals of plastic deformation in fully dense bulk nanocrystalline metals will be presented. The compacts with a mean grain size between 10 and 30 nm are prepared by an innovative and new combination of Inert Gas Condensation (IGC) and subsequent High Pressure Torsion (HPT) technique. The model system investigated is Pd (fcc) and several single-phase Pd alloys. The experiments focus on mechanical tests using new testing equipment for miniaturized specimens with different stress state conditions. The aim is to obtain a significantly improved database of materials behaviour for these alloys and to elucidate and describe the microscopic mechanisms that mediate the deformation for thermally robust samples.

Special emphasis will be addressed to *in situ* investigation of mesoscopic effects in plastic flow of nanocrystalline materials, such as formation of shear bands and/or cooperative grain boundary sliding. The obtained results are important not only for fundamental material science, but also allows to elaborate the principles of development of technically feasible nanostructured materials providing the highest level of strength and ductility of these materials. Several recent results will be discussed also in comparison with nanocrystalline materials prepared under different conditions. For example, nanosteels with bcc structure are becoming a major focus of recent research. The results of fundamental studies have important consequences also for engineering applications, such as surface wear, friction, surface stability, mechanical improvement and powder metallurgy and will be discussed in great detail.