Structural Studies of Nanocrystalline Metals

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Microstructure of metals (Cu, Fe, Mg, Cu with Al_2O_3) obtained by high-pressure torsion and its evolution with post annealing was studied by conventional powder diffraction in symmetric Bragg-Brentano geometry. This included evaluation of lattice parameters and texture but mainly line profile analysis in terms of both approximate modified Williamson-Hall method and total powder pattern (or multiple line profile) fitting [1-3]. Typical line-broadening anisotropy was explained by dislocation line broadening and elastic anisotropy. Dislocation density in the order of 10^{15} m^{-2} and crystallite size (~ 50 - 500 nm) were determined. The method was completed by X-ray film technique (area detection), diffuse scattering in the transmitted wave, transmission electron microscopy and life-time positron annihilation spectroscopy. Common features and differences for the microstructure evolution of studied metals are discussed.

Films made of small amount of colloidal Au nanoparticles prepared with pre-calculated size were investigated in parallel beam geometry. The diffraction line profile analysis also revealed strong line broadening anisotropy and indicated not only small crystallite size but also the presence of stacking faults and dislocations. The results were confirmed by conventional and high-resolution TEM and UV/vis spectroscopy

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