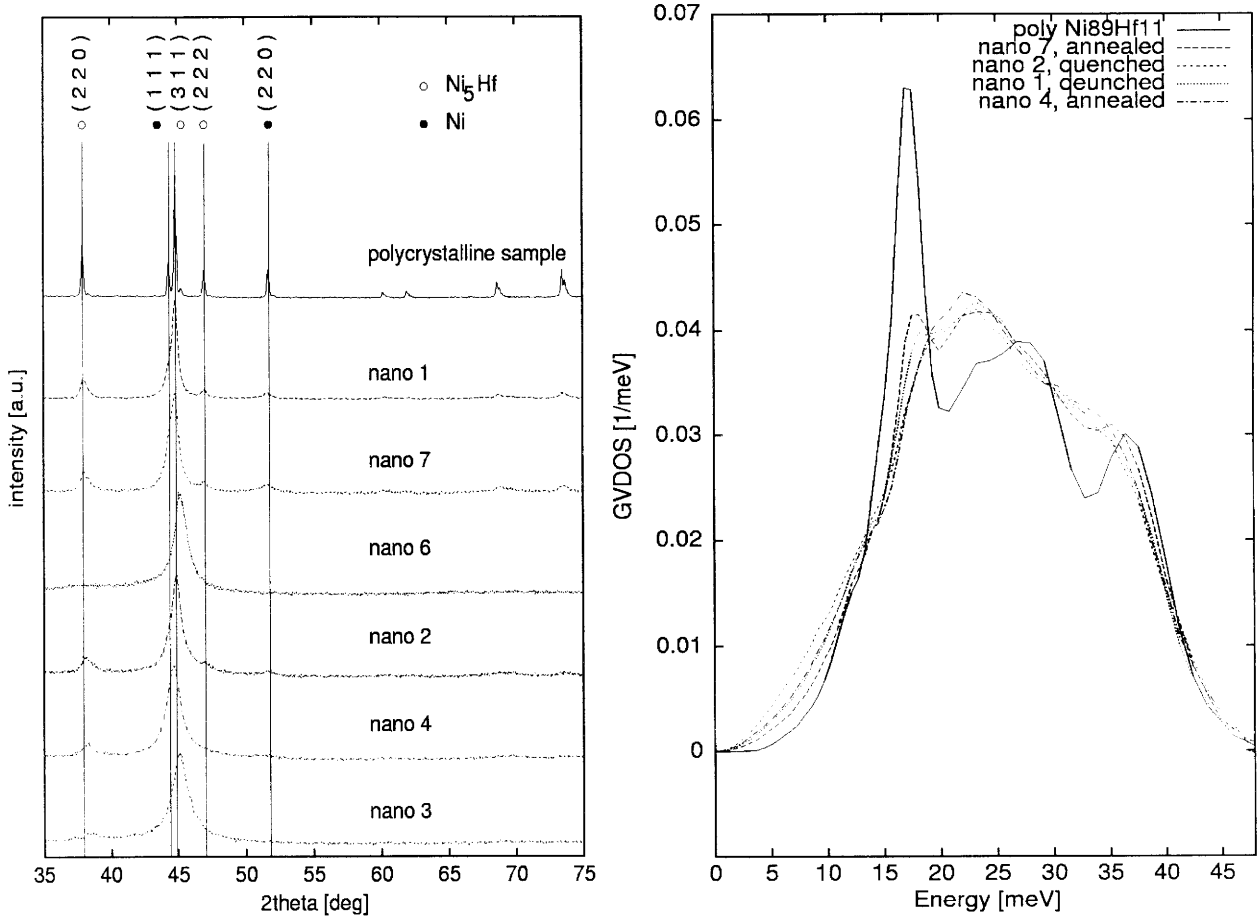
Atomic dynamics of rapidly quenched and annealed nanocrystalline $Ni_{89}Hf_{11}$

S. Mentese[a], J.-B. Suck[a], S. Janssen[b]

[a] Institute of Physics, Materials Research and Liquids, TU Chemnitz, 09107 Chemnitz, Germany

[b] Laborarory for Neutron Scattering, PSI, CH-5232 Villigen-PSI, Switzerland

We investigated the atomic dynamics of rapidly quenched and annealed nanocrystalline $Ni_{89}Hf_{11}$ by means of inelastic neutron scattering. The experiments were performed at room temperature at the cold neutron time-of-flight spectrometer FOCUS at the spallation source of the Paul Scherrer Institute. From the time-of-flight spectra we determined the generalized vibrational density of states. Using this we calculated the temperature dependence of the lattice part of the heat capacity and of the Debye-temperature. To characterize the nanocrystalline state we used x-ray diffraction, neutron diffraction, differential scanning calorimetry and high-resolution electron microscopy. The frequency distribution shows two significant results: First, in reference to the coarser grained material, the as-quenched nanocrystalline materials show a more enhanced generalized vibrational density of states at low energies than the annealed ones with almost the same average crystal size. Second, the enhancement is larger the smaller the grain size.



X-ray diffraction and GVDOS of nanocrystalline and polycrystalline $Ni_{89}Hf_{11}$