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Phase transformation in CrMnFeCoNi high-entropy alloy induced by high pressure torsion

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The forward and reverse phase transformation from face-centered cubic (fcc) to hexagonal close-packed (hcp) in the equiatomic high-entropy alloy (HEA) CrMnFeCoNi has been investigated with diffraction of high-energy synchrotron radiation. The forward transformation has been induced by high pressure torsion (HPT) at room and liquid nitrogen temperature by applying different hydrostatic pressures and shear strains (Fig. 1). The hcp phase fraction after pressure release and heating-up to room temperature as a function of these parameters has been determined by Rietveld analysis. It increases with pressure and decreasing temperature. Depending on temperature a certain pressure is necessary to induce the phase transformation. The onset pressure depends on hydrostaticity; it is lowered by shear stresses. The reverse transformation develops over a long period of time due to destabilization of the hcp phase. Moreover, the effect of the phase transformation on the microhardness of the HEA at room temperature will be demonstrated and discussed.

Keywords: High-entropy alloy, high pressure torsion, high-energy synchrotron radiation, phase transformation, microhardness

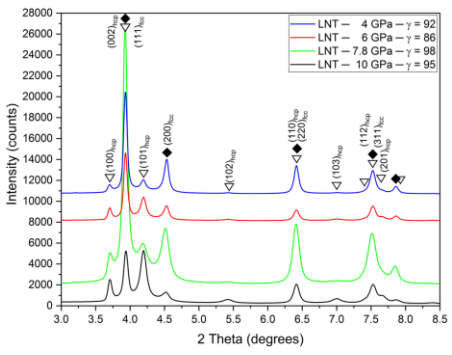

Fig. 1: Phase transformation from fcc to hcp during HPT at 77K and different pressures for a shear strain of about 100