SOLID SOLUTION HARDENING EFFECTS ON STRUCTURAL EVOLUTION AND MECHANICAL PROPERTIES OF NANOSTRUCTURED HIGH ENTROPY ALLOYS

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The equiatomic Cantor alloy and Ni-enriched derivates of it ($(CrMnFeCo)_xNi_{1-x}$ with x = 0.8, 0.4, 0.08 and 0) were deformed by high pressure torsion to the saturation regime and subsequently annealed up to 900°C. The HEA alloy compositions exhibits the highest solid solution strengthening, leading to the smallest saturation grain size as well as highest thermal stability, but a phase decomposition at intermediate temperatures. The differences in microstructural stability are also reflected by the mechanical properties as studied via Nanoindentation strain rate jump and constant contact pressure experiments. All alloys show pronounced pile-up around the indentation, which is even increasing after annealing, leading seemingly to a peak in hardness and modulus of the HEA alloys. After correction, the hardness of the HEA type alloys remains constant up to 450 °C (Ni60) or even increases up to 500 °C (Ni20) followed by a softening at higher annealing temperatures. Transients are observed during strain rate change, with a slightly enhanced rate sensitivity of the dilute alloys. Furthermore, stress reduction experiments indicate higher rate sensitivities at low applied contact stresses and small deformation rates. However, the Ni-based alloys remain fairly stable at RT deformation.