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Low Temperature Work Hardening Behavior of FeMnNiCoCr

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High entropy alloys

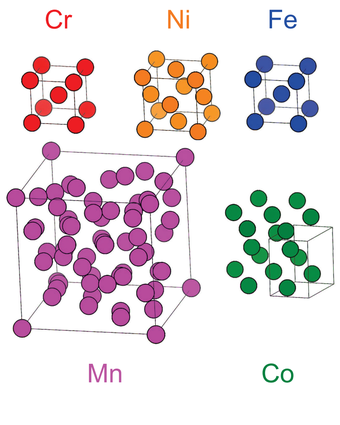
goal: **combination of high strength and good ductility in extended temperature range**

current metallic alloys: **single major element** (for example Fe, Al, Cu, Ni, ...)
with a **variety of alloying elements** of rather **small concentration**

high entropy alloys: more than five alloying elements in near equiatomic concentration
► **no major element**

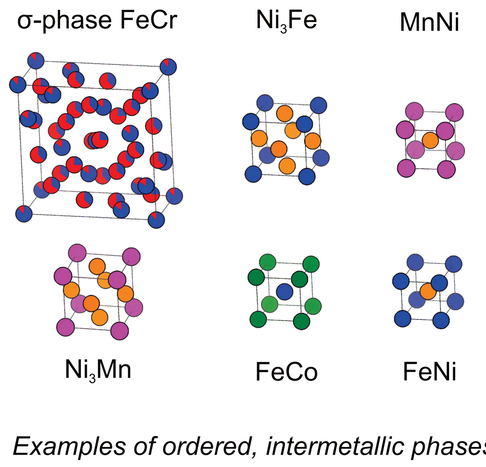
The most prominent high entropy alloy: FeMnNiCoCr

crystal structure of the alloying elements



Crystal structures of the initial elements.

suppression of brittle intermetallic phases

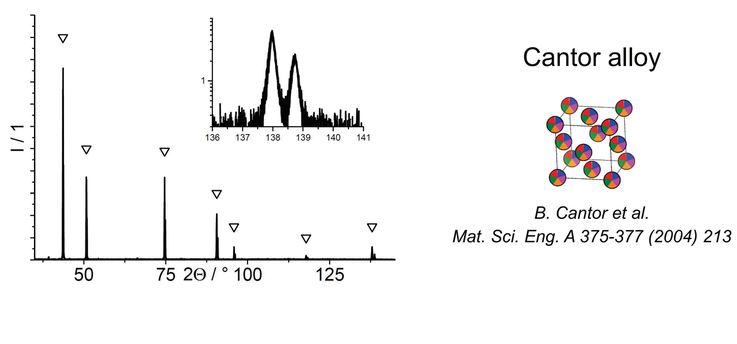


Examples of ordered, intermetallic phases within this multi-component system.

► **high ductility**

stabilization of a simple solid solution

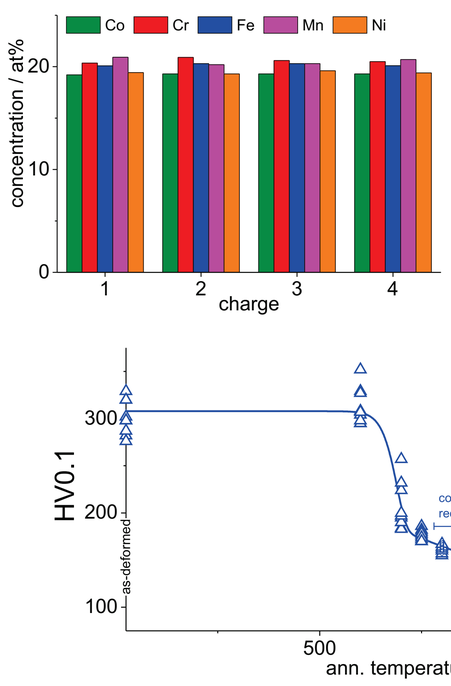
by increasing the number of possible atomic configurations

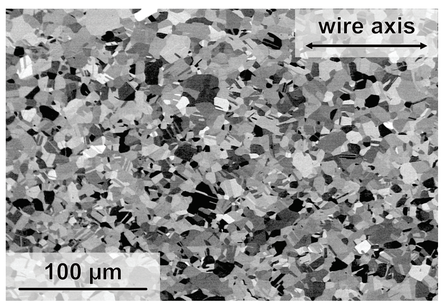


Simple crystal structure of the solid solution of FeMnNiCoCr. Confirmation by X-ray diffraction for the present samples.

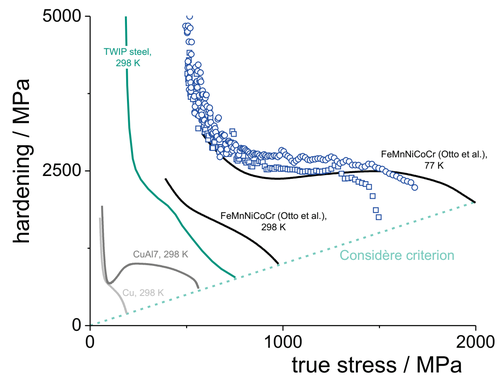
► **high strength by solid solution hardening**

Deformation behavior of FeMnNiCoCr



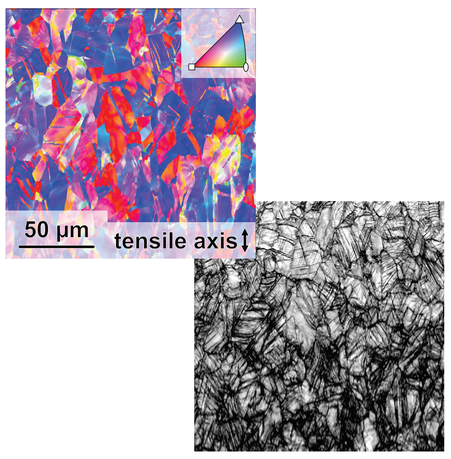


► **reproducibility by thermo-mechanical treatment:**
homogenization, cold-working, static recrystallization
► **precise determination of the investigated microstructure**



F. Otto et al. Acta Mat. 61 (2013) 5743
D. Geissler et al. Acta Mat. 59 (2011) 7711

Hardening at various temperatures and in comparison to various materials with varying stacking fault energy.



Changing microstructure during tensile loading at 77 K.

► **significant hardening at low temperature**
during tensile and compression loading
► **prevents necking ► high ductility**
► deformation is mediated by **dislocation slip and deformation twinning**
► tensile loading: combined <111> and <100> fibre texture
compression loading: <110> fibre texture
► tensile loading: twinning is active in
<111> fibre textured grains exclusively

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