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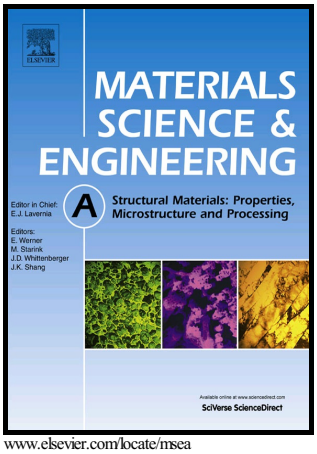

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Grain refinement of non-equiatomic Cr-rich CoCrFeMnNi high-entropy alloys through combination of cold rolling and precipitation of σ phase

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ABSTRACT

Grain refinement of non-equiatomic Cr-rich CoCrFeMnNi high-entropy alloys with an fcc structure was studied focusing on the precipitation of a Cr-rich σ phase along grain boundaries and shear bands. We found for the first time that the σ phase can be precipitated at the grain boundaries and the shear bands in the alloys at a significantly fast precipitation rate. The σ phase effectively suppressed the grain growth of the fcc matrix during recrystallization of the alloy after conventional cold rolling, resulting in a fine-grained microstructure with a mean diameter of approximately 1 μm. The alloys with this fine microstructure containing the σ phase exhibit high strength over a wide