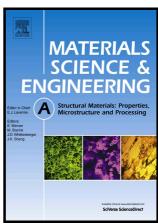
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#### **ACCEPTED MANUSCRIPT**

# Precipitation-hardened high entropy alloys with excellent tensile properties

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#### **Abstract**

To achieve balance of high strength and high ductility remains a difficult problem for metallic materials, especially in as-cast alloys. We combined the design concepts of high-entropy alloys (HEAs) and Ni-based superalloys, and designed two new Ni<sub>48.7</sub>Co<sub>17.5</sub>Cr<sub>10</sub>Fe<sub>9.3</sub>Al<sub>7.5</sub>Ti<sub>7</sub> and Ni<sub>47.7</sub>Co<sub>17.5</sub>Cr<sub>10</sub>Fe<sub>9.3</sub>Al<sub>7.5</sub>Ti<sub>7</sub>Mo<sub>1</sub> (at%) precipitation-hardened cast HEAs. Both two alloys have face-centered cubic (fcc) high-entropy matrix + nano  $\gamma'$  (Ni<sub>3</sub>(Al,Ti)-type) particles structure. Fine  $\gamma'$  particles with the average diameter less than 70 nm and 130 nm are homogeneously distributed in dendritic regions and inter-dendritic regions, respectively. The yield strength of Ni<sub>47.7</sub>Co<sub>17.5</sub>Cr<sub>10</sub>Fe<sub>9.3</sub>Al<sub>7.5</sub>Ti<sub>7</sub>Mo<sub>1</sub> alloy is 899 MPa, ultimate tensile strength is 1064 MPa and elongation is 14.3%. The strengthening theory is discussed. Attributable to substantial  $\gamma'$  precipitates, shearing strengthening mechanism plays an important role. Fracture is caused by micron-sized eutectic  $\gamma'$  phases that lead to stress concentration.

Keywords: High-entropy alloy, Crystal structure, Precipitation, High strength, High ductility

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