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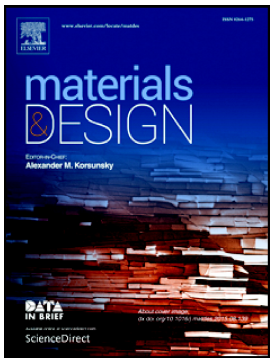

Development of a new high entropy alloy for wear resistance: FeCoCrNiW0.3 and FeCoCrNiW0.3+5at.% of C

Marco Gabriele Poletti, Gianluca Fiore, Flavia Gili, Davide Mangherini, Livio Battezzati

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Development of a new high entropy alloy for wear resistance: $FeCoCrNiW_{0.3}$ and $FeCoCrNiW_{0.3}$ + 5 *at. %* of C.

Marco Gabriele Poletti[1], *Gianluca Fiore*[1], *Flavia Gili*[2], *Davide Mangherini*[2], *Livio Battezzati*[1].

[1] Dipartimento di Chimica, Università di Torino, Via P. Giuria 7 10125 Torino. Italy

[2] GML – Metals, C.R.F. S.C.p.A, Corso Settembrini 40, Torino – Italy

A new high entropy alloy (HEA) has been synthesized using a predictive method recently developed. The alloy performance is compared to that of a benchmark commercial alloys (Stellite®6) as wear resistance material for coating automotive engine valves.

Using step by step predictive parameters the occurrence of an *fcc* solid solution with entropy of mixing higher than the conventional limit of 1.5 *R (*with *R* the gas constant*)* was singled out and verified in the $FeCoCrNiW_{0.3}$ composition. The as-cast ingot displays W segregation within the *fcc* grains as revealed by Scanning Electron Microscopy and X-Ray-Diffraction (XRD) patterns which were fitted by assuming the arc melted alloy contains two solid solutions. The segregation is eliminated by annealing at 1200°C for 3 hours. In these sample a $(Co\text{-}Fe)_7W_6$-type phase is found embedded in the solid solution matrix. Slip bands around indentation marks suggest low stacking fault energy of $FeCoCrNiW_{0.3}$. The high entropy alloy (HEA) has been hardened by adding *5 % at.* C to form carbides inside the *fcc* matrix. Conventional hardness, scratch and oxidation resistance tests show that the alloy compares well with Co-based Stellite®6 being the content of the expensive and strategical elements halved with respect to it.

Keywords: High Entropy Alloy; XRD; Scratch, Hardness; dispersion strengthening.

Highlights

- $FeCoCrNiW_{0.3}$ high entropy alloy predicted and synthetized.
- Slip bands around indentation marks could indicate alloy with stacking fault energy.
- Addition of 5 *at. %* of C to $FeCoCrNiW_{0.3}$ produces hard carbides in HEA matrix.
- Good resistance to oxidation in 700-900 °C range.
- Hardness and scratch hardness compare well with conventional more expensive alloys.

Graphical abstract