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Effect of nano Y_2O_3 dispersion on thermal, microstructure, mechanical and high temperature oxidation behavior of mechanically alloyed W-Ni-Mo-Ti

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Abstract: The present research deals with the fabrication of mechanically alloyed W based alloys with nominal composition of $W_{75}Ni_{10}Mo_{10}Ti_5$ (alloy A), $W_{74}Ni_{10}Mo_{10}Ti_5(Y_2O_3)_1$ (alloy B), $W_{73}Ni_{10}Mo_{10}Ti_5(Y_2O_3)_2$ (alloy C) (all in wt.%) by compaction at 500 MPa pressure for 5 min and conventional pressureless Ar injected sintering at 1500°C for 2 h. The phase evolution, microstructure, thermal characteristics, mechanical and high temperature behavior of the mechanically alloyed powders and sintered alloys has been studied by X-ray diffraction (XRD), Scanning electron microscopy (SEM), High resolution transmission electron microscopy (HRTEM), Energy dispersive spectroscopy (EDS) and Differential scanning calorimetry (DSC). Alloy C shows minimum crystallite size and maximum lattice strain, dislocation density of 18.6 nm, 0.54%, 36.71 $\times 10^{16}/m^2$ respectively at 20 h of milling as compared to other alloys. The activation energy for recrystallization decreases with increase in Y_2O_3 dispersion. The residual stress also enhances with increased Y_2O_3 content. Alloy C exhibits improved relative sintered density, hardness and elongation of 92.1%, 7.22 GPa, 12.73% respectively and appreciable wear resistance, high temperature oxidation resistance at 1000°C whereas maximum compressive strength of 1.91 GPa has been recorded in alloy B as compared to other alloys. Most interestingly the ductility also enhances with increase in Y_2O_3 dispersion.

Keywords: W-Ni-Mo-Ti alloy; Oxide dispersion strengthening; Hardness; Strength; Ductility; Oxidation.

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