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Role of Yttrium oxide [Y_2O_3] in Iron [Fe]

Arpan Arora
Indian Institute of Technology Roorkee, India

In the present work, iron, nickel and nano sized (20-30 nm) powders with compositions 42wt.%Ni, Fe-42wt.%Ni-2wt.%Y_2O_3 and Fe-2wt.%Y_2O_3 were prepared by high energy ball milling. The milled samples were sintered by spark plasma sintering (SPS) at 800°, 900° and 1000°C in argon atmosphere with a holding period of 5 min at a pressure of 60 MPa. The density of the sintered alloys increased from 78% at 800°C to 98% at 1000°C. XRD analysis indicates the presence of Fe-Ni phase in sintered the Fe-Ni alloy, while additional presence of intermetallic phases (Ni_5Y, $Fe_{17}Y_2$) and oxides (NiO, Fe_3O_4) observed in the sintered Fe-Y_2O_3 and Fe-Ni-Y_2O_3 alloys. The microstructures of the alloys sintered at 1000°C revealed decrease in average grain size from ~10 µm for Fe-Ni to ~1 µm for Fe-Y_2O_3 and ~500 nm for Fe-Ni-Y_2O_3. The Nano indentation hardness of the sintered alloys varied from 5.8 GPa for Fe-Ni to 7.2 GPa for Fe-Y_2O_3 and 7.9 GPa Fe-Ni-Y_2O_3. Sliding wear tests in dry conditions against alumina ball indicate that average coefficient of friction varied from 0.5 (Fe-Ni-$Y_2O_3$to 1.7 (Fe-Ni) and depth of wear track varied from 5 µm to 20 µm with change in composition of the alloy and sliding load (from 5 to 20 N). The presence of oxide rich layer at the contact surface is found responsible for less coefficient of friction and depth of wear track for the Fe-Ni-Y_2O_3 alloy. Corrosion tests in 3%NaCl indicate decreased corrosion density (Icorr) from 1.34µA/cm^2 for FeNi and 0.78 µA/cm^2 Fe-Ni-Y_2O_3. The present research work essentially indicates a significant grain refinement with subsequent improvement of mechanical, wear and corrosion properties due to the addition of nano sized yttrium in iron -nickel alloy.

Biography

Arpan Arora has completed his Master of Technology in Material Engineering at the age of 24 years from Indian Institute of Technology Roorkee India one of the Most Reputed college in India. Now he is working as a Junior Research Fellow at Indian Institute of Technology Madras-India. [India's best institute Rank 1]. He is the admin of three Facebook page, followed by 15000 people and total sighted are 50000+. On these pages he share latest research basic concepts and history related to metallurgy and materials engineering.

arora.arpan5@gmail.com

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