Resonant photoemission studies on Fe-Ni alloys

V. R. Rao Medicherla
Department of Physics, ITER, SOADU
Bhubaneswar - 751030, India

The electronic structure of $Fe_{1-x}Ni_x$ (x=0.32, 0.36, 0.4, 0.5) alloys was investigated employing high resolution photoelectron spectroscopy using synchrotron radiation. The valence bands and the core levels have been recorded at various resonant off resonant photon energies. Very intense Ni $L_3M_{4,5}M_{4,5}$ Coster-Cronig Auger transition is observed in the valence bands of the alloys recorded at Ni 2p-3d on resonance photon energy (853 eV) whose intensity comes down with decrease of Ni content in the alloys and becomes very small in Invar alloy (x = 0.36). The drastic decrease of intensity of Ni $L_3M_{4,5}M_{4,5}$ Auger is due to the microscopic in-homogeneties in compositon which gkives rise to varying core hole screening for different Ni sites. The electron-electron interaction energy (U_{dd}) of Ni 3d shell is found to decreases with the decrease of Ni concentration. The 3p and 3s core levels of Fe and Ni recorded at 707 eV (Fe L_3 edge) are overwhelmed by various intense resonant Auger features such as Fe $L_3M_{2,3}M_{2,3}$, Fe $L_3M_{2,3}M_{4,5}$ and Fe $L_3M_1M_{4,5}$. The ^1S state of Fe $L_3M_{2,3}M_{2,3}$ is greatly enhanced in the Invar alloy as compared to other alloys. An anti resonance dip is observed in both Fe 3d and Ni 3d states indicating the itinerant nature of the conduction electrons. Both Fe 3d and Ni 3d states are hybridized upto 4 eV bindign energy from Fermi energy. In Fe-Ni alloys, the composition dependence of screening and hybridyzation effects seems to play a crucial role in determining the electronic structure.