High Pressure Mössbauer Spectroscopic Studies on Narrow Band Co$_{1-x}$Fe$_x$S$_2$ Systems up to 9GPa

USHA CHANDRA, Department of Physics, University of Rajasthan, Jaipur 302004 India — Pyrite type 3d-transition metal disulfides exhibit a wide variety of interesting electrical and magnetic properties. CoS$_2$ is a ferromagnetic metal ordering ferromagnetically below ~120K while FeS$_2$ is a narrow band gap diamagnetic semiconductor. Both Co and Fe are in low spin configuration. Formation of solid solutions between these two end members opens up the possibility of tuning the position of Fermi level in Co$_{1-x}$Fe$_x$S$_2$. Nano crystalline systems Co$_{1-x}$Fe$_x$S$_2$ (x=0.1 to 1.0) identically synthesized adopting solution technique were characterized by XRD, TEM. All the systems except x=0.8 showed nano sized particles. TEM micrographs taken for Co$_{0.2}$Fe$_{0.8}$S$_2$ system showed nano wires formation with SAED images indicating crystalline pattern. Electrical resistivity of bulk Ferromagnetic pyrite compounds Fe$_x$Co$_{1-x}$S$_2$ have shown an anomalous temperature dependence with increasing magnetic order below curie temperature due to the effect of a change in band width. Shift in the absorption edge with pressure in bulk pyrite FeS$_2$ has been attributed to large compaction of S-S bonds in comparison to Fe-S bonds. $^{57}$Fe Mössbauer spectroscopic investigations on systems under high pressure are sensitive enough to probe variations in valence, spin configuration and site occupancy of Fe. The high pressure Mössbauer spectroscopic measurements using diamond anvil cell on nano crystalline Co$_{1-x}$Fe$_x$S$_2$ (x=0.2,0.5 and 0.8) would be reported to understand the pressure effect on band gap.

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