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Co-existence of Spin Density Wave and Jahn-Teller Distortion in Iron Oxypinctide Superconductors : A Two Band Tight-Binding Model Approach

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Abstract: The recently discovered iron based oxypinctide superconductors exhibit an interesting interplay of spin ordering, orbital ordering, superconducting ordering beside stripe phases. These superconductors are bad metals and poor insulators. All the five 3d-electrons of the iron ion contribute substantially to display the physical parameter. We propose here a two band model consisting of the contributions of d_{xz} and d_{yz} orbitals, which lie near the Fermi surface. The model consists of two degenerate bands due to d_{xz} and d_{yz} electronic states with same kinetic energy ε_k , which consists of the contributions up to fourth nearest neighbor. The Jahn-Teller(JT) distortion removes the degeneracy of the conduction band by introducing JT gap of magnitude 2Ge in both the bands. The two orbitals are hybridized with a weak electron momentum dependent energy $\varepsilon_{xy}(\mathbf{k})$. We introduced the mean-field level spin density wave(SDW) gap with same spin gap parameter (Δ_s) , with same nesting wave vector 'Q' in both the orbitals. The four coupled electron Green's functions are derived by using Zubarev's Green's function technique and the quasi-particle bands are calculated. The gap equations for SDW and lattice distortion are calculated from these Green's functions and are solved self consistently. Similarly electron density of states, which is proportional to the tunneling conductance measured by scanning tunneling measurements (STM) is calculated and compared with the experimental data. The gap equations are studying by varying different physical parameters of the system.

Keywords : Iron oxypinctide superconductors, spin density wave interactions, Jahn-Teller distortion.

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