



Conclusions

When Zn (non-magnetic ion) is doped at the Mn site of MnV_2O_4 the system moves from localized to itinerant electronic behavior whereas for Cr (Magnetic ion) doping the system moves from itinerant to localized electronic behavior which is the characteristic of a narrow band where the appearance of a double-well bond potential introduces lattice instabilities.

For the region of the localized electron limit the mobility of the electronic polarons dominate and at the crossover from itinerant to localized electronic behavior the mobility of the polaronic holes dominate.

When Zn content increases the chemical pressure increases which reduces the residual spins on the V-V pairs which leads to the decrease of long range magnetic ordering. As a consequence coupling between orbital and spin degrees of freedom decreases.

When Magnetic Co is doped in ZnV_2O_4 the V-V separation decreases very slightly, but T_N decreases suggesting that the inter-atomic Coulomb energy U in the localized electron superexchange theory is not constant when Co is doped.

The activation energy decreases with the decrease of V-V distance as the metal-insulator transition is approached from the localized-electron side which confirms the reduction of U/t with decrease of V-V distance, which might be due to a partial delocalization of electrons and in this limit neither the localization-electron model and nor the itinerant-electron model is applicable.

Along with T_N , also the charge gap and activation energy of the vanadates depend on the V-V separation and as it decreases a breakdown of localized electron model for the 3d electrons is observed.

By tuning the V-V distance either by external pressure or chemical pressure we can tune the magnetic, ferroelectric and transport properties or more specifically, the multiferroic properties of Mott-insulating FeV_2O_4 which is very important from the application point of view.