# 電子ドープ(In, Fe)As における強磁性の発現機構

# Controlling ferromagnetism of (In, Fe)As semiconductor by electron-doping

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In 2012, P. N. Hai *et al.* proposed that by introducing isoelectronic iron (Fe) magnetic impurities and Beryllium (Be) double-donor atoms into InAs, it is possible to grow an n-type ferromagnetic semiconductor (FMS) with the ability to control ferromagnetism by both Fe and independent carrier doping by low-temperature molecular-beam epitaxy [1]. This is a remarkable result because n-type carrier-induced ferromagnetic semiconductors (FMS) are still missing.

Based on that experimental result, using the Korringa-Kohn-Rostoker coherent potential approximation (KKR-CPA) method and Monte Carlo simulation [2], we study the electron-induced ferromagnetism of (In,Fe)As. We show that with doped Be atoms occupying in interstitial sites, chemical pair interactions between atoms and magnetic exchange interactions between Fe atoms change when number of doped electrons change. Therefore, by controlling the doping process, not only the distribution of atoms in the material but also the ferromagnetism could be controlled.

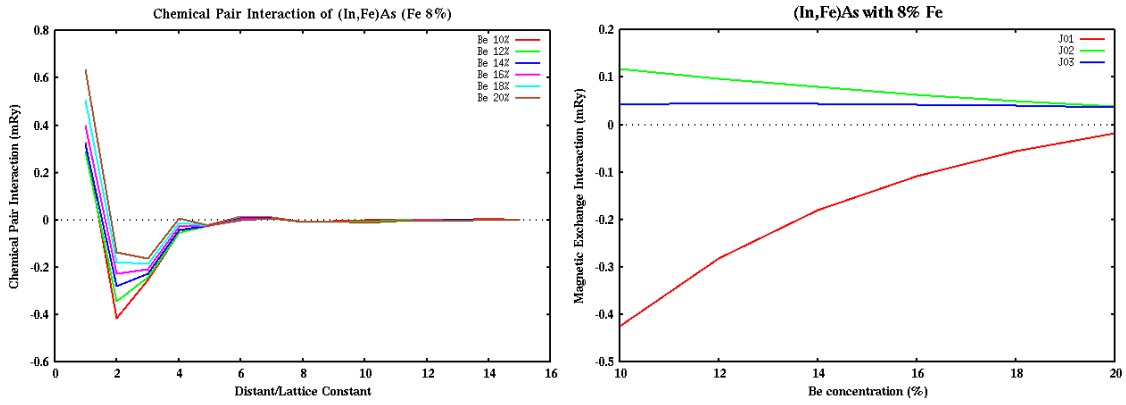


Figure: (left) Chemical pair interactions of (In,Fe)As with 8% Fe. Doped Be concentrations are from 10% up to 20%. (right) Be concentration-depended magnetic exchange interactions between first (red), second (green), third (blue) nearest neighbors of Fe atoms in (In,Fe)As with 8% Fe.

[1] P. N. Hai et al., Appl. Phys. Lett. **101**, 182403 (2012)
[2] K. Sato et al., Rev. Mod. Phys. **82**, 1633 (2010)