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Interstitial Cu Codoping Method for High Curie Temperature (Ga,Mn)As HITOSHI FUJII, KAZUNORI SATO, HIROSHI KATAYAMA-YOSHIDA, Department of Materials Engineering Science, Graduate School of Engineering Science, Osaka University, Japan, LARS BERGQVIST, RetiredDepartment of Materials Science and Engineering, KTH Royal Institute of Technology, SE-100 44 Stockholm, Sweden, PETER H. DEDERICHS, Peter Gruenberg Institut, Forschungszentrum Juelich, D-52425 Juelich, Germany — Based on first principles calculations, we propose a solubility control method of magnetic impurities in dilute magnetic semiconductors (DMSs). We show that donor atoms, such as Cu, introduced at the interstitial sites in GaAs enhance the solubility of Mn. As a result, Mn can be doped to more than 20 percent in GaAs in the thermal equilibrium condition [1]. Due to the carrier-induced nature of the ferromagnetism in DMSs, the ferromagnetism is suppressed because of the compensation of hole from Mn acceptors by the codoped interstitial Li or Cu. In order to recover the ferromagnetism, we propose low temperature annealing after crystal growth to remove only the interstitials. Our NEB(Nudged Elastic Band method) calculation results show that the effective migration barrier of Cu in GaMnAs is about 0.2eV. This value is small compared with the migration barrier of Li in GaMnAs (about 0.5eV). Even if Li, it is possible to diffuse Li in ($Ga_{0.7}$,$Mn_{0.3}$)As at 0.12 micron in 24 hours [2]. In case of Cu, therefore, we can expect further annealing distance than Li case because of the low migration barrier.

[1] H. Fujii, et al.:Appl. Phys. Express 4 (2011) 043003.
[2] L. Bergqvist, K. Sato: Phys. Rev. B 83, 165201 (2011).

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