Manifestation of Vacancy-As complexes in As doped GeSn epilayers

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Epitaxial GeSn films doped with Arsenic are suitable for source-drain (S/D) stressors of n-FETs to obtain a sufficient conductivity of the source and the drain area. S/D stressors boost the carrier mobility to improve transistor performance [1]. Moreover, As is a possible candidate in order to overcome issues in forming n-type Ultra-shallow junctions (USJs) on Ge [2]. During the process of active doping with As, vacancies are formed in the GeSn:As epilayers. However, vacancy complex (V_x-As_y) level increases resistivity of the GeSn:As epilayers by passivating dopants along with a reduction of the lattice strain induced by As atoms.

Positron annihilation spectroscopy (PAS) is well suited to investigate vacancy complexes in narrow band gap semiconductors. PAS technique in Doppler and Coincidence Doppler mode was applied on GeSn epitaxial layers (thicknesses ~ 70 nm), grown by chemical vapor deposition with different mass flow ratio (AsH_3/GeH_4), high active As concentrations ($\sim 10^{19}$ cm^{-3}), and similar Sn concentrations (6-6.7%). Positron traps are identified as mono-vacancy complexes. Larger mono-vacancy complexes (V-As_x) are formed with the increase of the As concentration. (V-As_x) complexes increase the dopant deactivation of the sample epilayers. The mass flow ratio shows a significant impact on the defect distribution in GeSn layer.

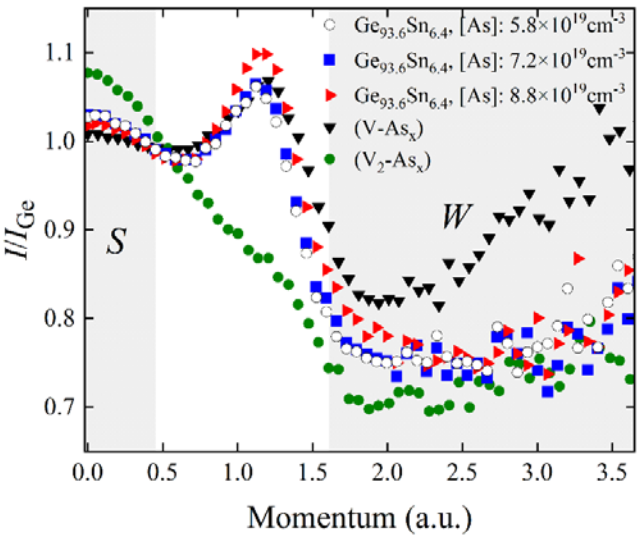

Figure 1 *Annihilation intensity ratio for three different samples with CDOBS. Data were compared with two previous studies. (V-As_x) was studied from ref [3], whereas, (V_2-As_x) was analyzed from ref [4].*

References

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