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Carrier density dependence of spin lifetime in Fe/AlGaAs heterostructures JOON-IL KIM, JENNIFER MISURACA, KONSTANTINOS KOUNTOURIOTIS, STEPHAN VON MOLNAR, PENG XIONG, Florida State University, KANGKANG MENG, JUN LU, LIN CHEN, XUEZHE YU, JIANHUA ZHAO, Institute of Semiconductors, Chinese Academy of Sciences, Beijing, China
— Electrical Hanle-type measurements have been performed to determine spin lifetimes at various carrier densities in Si:$Al_{0.3}Ga_{0.7}As$, a persistent photoconductor (PPC). The carrier density of this material can be tuned, changing it from insulating to metallic *in situ* via photo excitation. Utilizing this PPC effect, we conduct electrical measurements of spin accumulation and transport under the same experimental conditions without the necessity of making replicas to realize different doping levels. We report the carrier density dependence of the spin lifetime derived from Hanle measurements with spin devices formed on wafers which have different graded junctions and Si doping levels. Carrier densities ranged from 3.5x10^{16} to 2.4x10^{17} cm^{-3} and from 7.2x10^{16} to 6.5x10^{17} cm^{-3} in two different samples. The spin lifetimes (determined using Lorentzian fits to the Hanle curves) ranged from 0.5 to 2.8 ns. From optical studies, the spin lifetime at zero bias and at low temperature in n-GaAs was reported to be larger than 100 ns on the insulating side and ∼80 ns on the metallic side. Based on our measurements in Si:$Al_{0.3}Ga_{0.7}As$, the extrapolated spin lifetime at zero bias and at 5 K is found to be only ∼2.3 ns on the insulating side and decreases with increasing bias current.

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