Spin transport in a strained SiGe alloy

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Spin transport in group-IV channels on a Si platform has been studied in detail [1,2]. Recently, we reported pure-spin-current transport in a Ge-rich $Si_{0.1}Ge_{0.9}$ (SiGe) alloy [3] for developing group-IV semiconductor spintronic devices. Here we report the first experimental demonstration of spin transport in a strained SiGe alloy by all electrical means.

By using molecular beam epitaxy (MBE), a strained *n*-SiGe spin transport layer (~80 nm) was grown on a Ge/Si(111) virtual substrate. To promote the tunneling conduction of electron spins through Schottky barriers, P δ-doped Ge capping layer (~8 nm) was grown on top of the SiGe layer [2,3]. Finally, we grew a $Co_2FeAl_{0.5}Si_{0.5}$ (CFAS) ferromagnetic layer (~10 nm) [2,3]. Schematic of the grown heterostructure is shown in Fig.1(a). The presence of the strain in the SiGe layer is confirmed by comparing XRD rocking curve with that of the relaxed SiGe layer in Ref. [3], as shown in Fig.1(b). Both of the SiGe layers have almost the same carrier concentration (n = 4~5×10^{18} cm^{-3} at 50 K). Figure 2(a) shows that electron mobility (μ) is largely improved for the strained SiGe layer.

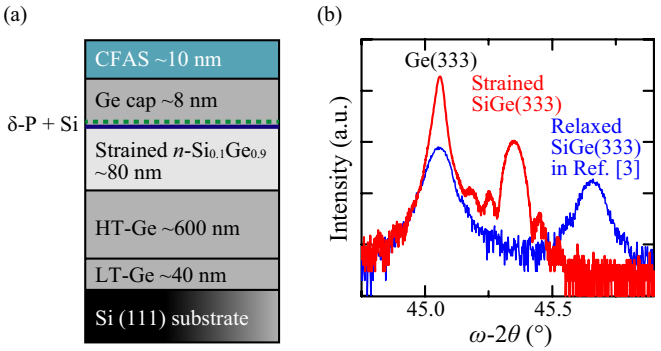

Fig. 1(a) Schematic of the grown CFAS/$Si_{0.1}Ge_{0.9}$/Ge/Si(111) heterostructure. (b) XRD rocking curves around Ge(333) peak for the strained SiGe layer on the Ge/Si(111) virtual substrate, compared with relaxed SiGe in Ref. [3].

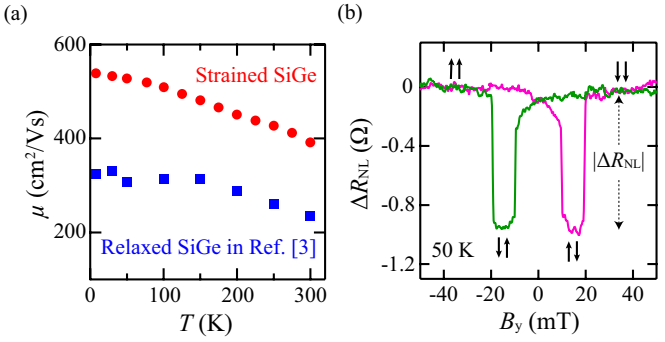

Fig. 2(a) Comparison of electron mobility (μ) between the strained and relaxed SiGe layers. (b) Nonlocal spin signal of a strained *n*-SiGe lateral spin valve at 50 K.

Using the strained *n*-SiGe, we fabricated lateral spin valve (LSV) devices. Figure 2(b) shows a representative spin signal (ΔR_{NL}) detected by four terminal nonlocal measurements at 50 K. The magnitude of ΔR_{NL} (~ 0.95 Ω) for the strained SiGe layer is markedly larger than that (~ 0.002 Ω) in the relaxed one in Ref. [3]. I will discuss the effect of the strain on electrical properties, spin transport, and spin relaxation in SiGe [4].

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