

Room-temperature two-terminal magnetoresistance ratios in Ge-based vertical spin-valve devices with Co₂FeSi

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Ge-based vertically stacked spin devices on Si are one of the attractive candidates for future semiconductor spintronic applications. To obtain large magnetoresistance (MR) ratios at room temperature, it is important to utilize highly spin-polarized electrodes such as Co-based Heusler alloys even in the vertical spin devices although it is difficult to suppress the atomic interdiffusion between Co-based Heusler alloys and Ge during the growth process [1]. In this study, we report on over 1% MR ratios at room temperature in vertical spin-valve (VSV) devices using an epitaxial Co₂FeSi layer as one of the two ferromagnetic electrodes.

Fabricated VSV structures consisting of CoFe/Ge/Co₂FeSi/Fe₃Si multilayers on Ge-on-Si(111) is shown in Fig. 1(a). To improve the quality of Co₂FeSi and to suppress the interdiffusion at Ge/Co₂FeSi interface, an Fe₃Si buffer layer is inserted on Ge-on-Si(111). Representative MR curves for devices with and without Co₂FeSi are shown in inset of Fig. 1(b). The value of ΔR_s for the device with Co₂FeSi is one order of magnitude larger than that without Co₂FeSi. Notably, the MR ratio for the device with Co₂FeSi at room temperature is estimated to be ~1.4 % [2]. With decreasing temperature, the MR ratio increases up to ~4.2 % at 30 K. On the other hand, the MR ratio for the device without Co₂FeSi is decreased with decreasing temperature. The above difference can be explained by the difference in the influence of the Fermi-level pinning between Co₂FeSi/p-Ge and Fe₃Si/p-Ge interfaces [3], leading to the difference in the resistance value in the parallel magnetization state under the MR measurements. In this talk, we will discuss these features in detail.

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References

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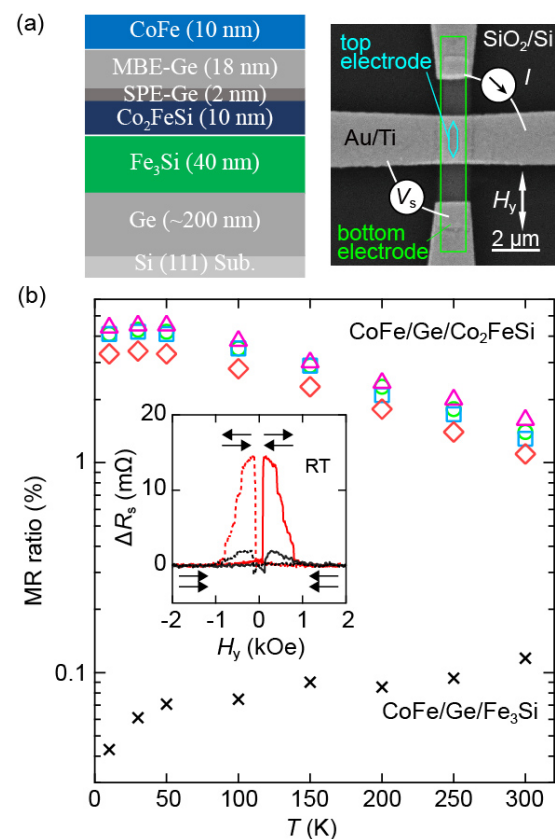


Fig. 1 (a) Schematic and SEM image of a fabricated vertical spin-valve (VSV) device. (b) Temperature dependence of the MR ratios for devices with (red) and without (black) Co₂FeSi. The inset shows MR curves for the devices.