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Enhancement of CPP-GMR by a CuZn alloy spacer layer

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CPP-GMR devices using cobalt-based Heusler alloys combined with Cu or Ag for a spacer layer have been extensively investigated. Alloys such as $L2_1$ Rh_2CuSn [1] or B2 NiAl [2] with the same bcc structure as Heusler alloys have been also tried instead of such fcc metals from the expectation that the improved band matching at the interface with a Heusler alloy can enhance MR. However, a drawback of these alloys is the short spin diffusion length, which may degrade the MR properties. In this work, a Cu-based bcc alloy without heavy or magnetic elements, B2-type CuZn, was selected for a spacer layer. A Heusler alloy $Co_2FeGa_{0.5}Ge_{0.5}$ (CFGG) was used for magnetic layers.

The films were deposited by magnetron sputtering on MgO (001) single crystalline substrates kept at room temperature. The films for pseudo-spin-valve type CPP-GMR devices have the stacking structure of sub./Cr(10)/Ag(100)/CFGG(10)/CuZn(5)/CFGG(10)/Ag(5)/Ru(8), where the numbers indicate the thicknesses in nm. The samples were annealed at temperatures up to 500°C for obtaining better structural ordering of CFGG.

X-ray diffraction and ross sectional TEM studies indicate that the epitaxial growth of each layer and the structure does not change by annealing at temperatures up to 350°C. Figure 1 shows the distribution of the change of the resistance-area product ΔRA for about 40 devices prepared at the same time. Overall, the CuZn spacer gives higher values of ΔRA than those for the Ag spacer. The value exceeds 10 mΩ·μm^2 for T_a=350 °C. Thus, CuZn is a promising spacer material to be combined with Heusler alloy magnetic layers for obtaining high MR outputs.

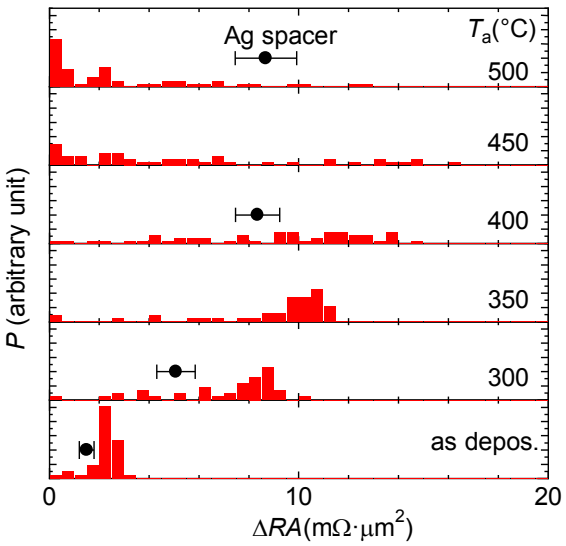

Fig. 1: Distribution of ΔRA of the CPP-GMR devices with CuZn spacer for each annealing temperature T_a. The black dots indicate the average values of ΔRA for the devices using Ag spacer [3].

References

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