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 L2₁, Rh₂CuSn [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 Co₂FeGa₀.₅Ge₀.₅ (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 CFFG.

X-ray diffraction and cross 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 ∆RA for about 40 devices prepared at the same time. Overall, the CuZn spacer gives higher values of ∆RA than those for the Ag spacer. The value exceeds 10 mΩ·µm² for Tₐ=350 °C. Thus, CuZn is a promising spacer material to be combined with Heusler alloy magnetic layers for obtaining high MR outputs.

References

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