**Carrier doping effect on all-Heusler giant-magnetoresistance junctions with semimetallic Fe2VAl**

**studied by first-principles calculations**

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For read sensors of ultrahigh-density hard disk drives (HDD) and Gbit-class spin transfer torque magnetoresistive random access memories (STT-MRAMs), magnetoresistive (MR) devices satisfying high MR ratio and small resistance–area (RA) have been required. Current-perpendicular-to-plane giant magnetoresistive (CPP-GMR) junctions are expected to be one of the good candidates that have much smaller RA than tunneling magnetoresistive junctions. However, small RA values are not suitable for read sensors, because high voltage output can not be obtained. Therefore, new junctions with a semiconducting spacer has drawn much attention [1,2]. In this work, we investigate interfacial magnetic couplings and spin-dependent transport property in all-Heusler based CPP-GMR junctions with a semimetallic Fe2VAl spacer on the basis of first-principles calculations. A half-metallic ferrimagnet Mn2VAl is used for a spin injector and is thought to be highly promising for spintronics devices at room temperature because the expected current to flip the spin would be rather low. The Korringha-Kohn-Rostoker (KKR) Green’s function method with the AkaiKKR code is utilized to compute the magnetic coupling constants between the magnetic atoms. For calculating the ballistic conductance, we use the PWCOND code which is part of Quantum-Espresso package. It is found from our calculations that, in MnMn-VAl termination, the interfacial Mn atoms are antiferromagnetically coupled with V atoms of Fe2VAl. In addition, half-metallic states are also preserved in the interfacial reigion. The transport property is governed by an electron pocket in the band structure, originating from the V *d* states. Electron-carrier doping in Fe2VAl enhances the conductivity, while hole-carrier doping hardly affects it. This carrier doping effect from band matching leads to a new function in CPP-GMR junctions. When carriers are introduced in the spacer by a gate voltage, magnetoresistance might be changed significantly. Moreover, from comparison with spin injectors with other half-metallic Heusler alloys, controlling mechanisms in this type of CPP-GMR junctions is discussed.

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