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Giant spin accumulation and long-distance spin precession in metallic lateral spin valves

YASUHIRO FUKUMA, RIKEN

The non-local spin injection technique in lateral spin valves (LSVs) has provided not only scientific interests to study spin transport and relaxation in a nanowire but also potential spintronic device applications. The non-local method involves no charge-current flow but spin accumulation in the nonmagnetic wire. In order to increase the output signal, related to the spin accumulation splitting for electrochemical potential, efficient spin injection into nonmagnet from ferromagnet as well as high applied current are indispensable. The spin resistance mismatch between the ferromagnet and the nonmagnet needs to be overcome by using high interface resistance such as tunnel barrier for the efficient spin injection, while a low junction resistance is preferred for applying high current. In this talk, I will discuss a guideline to design metallic LSVs with high output signal. The interface resistance of around 0.1 $\Omega\mu$m2, several orders of magnitude smaller than that of a typical tunnel junction, could effectively overcome the spin resistance mismatch in the metallic system [1] and leads to the giant spin accumulation signal over 200 μV in LSVs with NiFe/MgO/Ag junctions [2,3]. The Hanle effect measurements demonstrate a long-distance collective 2π spin precession along the 10 μm long Ag wire. This result will accelerate the development of novel spintronic devices utilizing the pure spin current and the spin accumulation.

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