MAR16-2015-001218

Abstract for an Invited Paper
for the MAR16 Meeting of
the American Physical Society

Quasiparticle-mediated spin Hall effect in a superconductor

TARO WAKAMURA, Univ of Paris - Sud 11 CNRS

Superconductivity often brings novel phenomena to spintronics. According to theoretical predictions, superconductivity may enhance the spin Hall effect (SHE) due to the increase in the resistance of superconducting quasiparticles which mediate spin transport in superconductors. In this work, we show a first experimental observation of quasiparticle-mediated SHE in a superconducting NbN, which exhibits an enormous enhancement below the superconducting critical temperature (T_{C} =10 K). We fabricated a lateral device structure composed of Py (NiFe) and NbN wires bridged by a nonmagnetic Cu wire. A pure spin current is generated in the Cu bridge by a spin injection current (I) between the Py and the Cu, and absorbed into the NbN wire. The absorbed spin currents are converted into charge currents via the inverse SHE, thereby generating the inverse SH voltage (V_{ISHE}). When NbN is in the normal state at 20 K ($>T_{\mathrm{C}}$), inverse SH signals ΔR_{ISHE} ($R_{\mathrm{ISHE}} \equiv V_{\mathrm{ISHE}}/I$) are independent of$I$. However, at 3 K ($<T_{\mathrm{C}}$), as I decreases ΔR_{ISHE} dramatically increases, and when I =0.01 μA, the signal becomes more than 2000 times greater than that in the normal state. Our experimental demonstration shows a great potentiality of superconductors for spintronics and its future applications.