Efficient spin to charge current conversion in WSe2 by spin pumping from CoFeB.

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Abstract

The key for a successful integration of electronics and spintronics is mastering the spin-charge conversion phenomena. Since the discovery of this phenomena, 3D materials with large spin-orbit coupling (SOC) have been used to produce spin currents using inverse spin Hall effect. The importance of the interface effects in these systems, and the search for materials with a richer physics, have move the focus to 2D materials, specifically to the family of the transition metal dichalcogenides (TMD) [1]. TMDs materials present a strong SOC effect, exhibit remarkable spin momentum locking due to the Rashba effect and have varied band gaps, making TMDs based devices the cornerstone for the next generation of spintronics and optoelectronic devices.

In this work we have perform spin pumping measurements using microwaves in the X band (9 GHz) in a microwave cavity mode on a Bruker EMX Plus, at room temperature, on multilayer system comprised of //STO/1T'-WSe2/Au/CoFeB/Al. The ferromagnetic resonance spectrum shows (Fig.1(a)) a resonance at 89.5 ±1 mT for 0° and 180 ° while the electromotive signal (Fig.1(b)) is centered at the same field position. The fit of the voltage signal yields an amplitude of 74 µV at 0° (214 µV at 180°) for the symmetric component of the signal. The voltage achieved at 180° is one order of magnitude bigger than the voltages measured for similar systems using 3D materials such as Pt [2] or Ta. Even more, the symmetric voltage achieved is an order of magnitude bigger than for the sample without the Au spacer between the FM and the TMD. We ascribe this behavior to the improvement of the interfaces between FM and Au and TMD and Au and the lack of intermixing between FM and TMD.

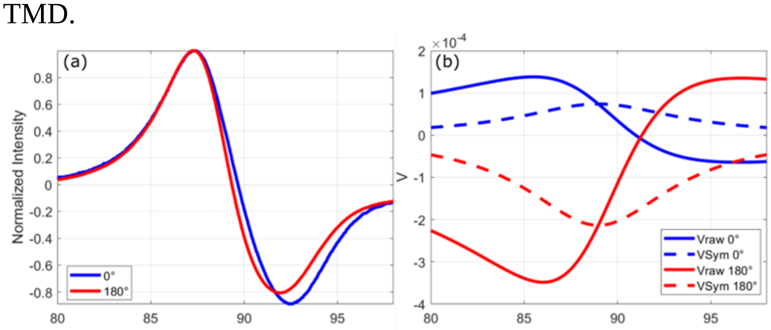

Figure 1: (a) Ferromagnetic resonance spectrum of //STO/1T'-WSe2(1ML)/Au/CoFeB/Al, obtained at 9GHz and 195 mW, for an orientation of 0° and 180° between the plane normal and the external magnetic field. (b) Measured raw (Vraw) voltage and its symmetric (VSym) component for 0° and 180°, produced by spin pumping on CoFeB onto the TMD layer.

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References

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