Spin current generation in paramagnetic insulators

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Up to now, the discoveries of new materials which show spintronic functions have stimulated progress in spintronics. After the demonstration of the injection/propagation/detection of spin currents in normal metal (NM)/ferrimagnetic insulator junctions [1], a magnetic ordering insulator becomes an important player in spintronics. In addition to the magnetically ordered insulators, paramagnetic insulators are found to appear as spintronics materials showing several spintronic functions such as spin pumping [2], spin Seebeck effects [3], long-range spin transport [4] and spin Hall magnetoresistance [5].

Here, we investigated the spin current generation in NM/paramagnetic insulator (PI) junctions. We modeled a general formula of the interface spin current at NM/PI based on a linear response approach and applied the model to explain the experimental observation of paramagnetic spin Seebeck effects in the Pt/$Gd_3Ga_5O_{12}$ junction. The comparison between the calculation and experiment reveals the role of the interfacial spin current in the paramagnetic spin Seebeck effect [6]. In addition, our new experimental results indicate the importance of bulk spin transports in the paramagnetic spin Seebeck effect.

This research is collaboration with Prof. Saitoh, Assis. Prof. T. Kikkawa, Dr. S. Takahashi.

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