Title:

From spin transfer torque, the spin Hall torque, to spin-orbit torque in magnetic heterostructures: An experimentalist’s point of view

磁性異質結構中的自旋矩、自旋霍爾效應矩和自旋軌道矩：一個實驗學者的觀點

Abstract:

The theory of spin transfer torque (STT) in magnetic multilayer systems was first proposed by Slonczewski and Berger in 1996 [1, 2]. Later it has been proved by experiments on submicron-sized devices (spin valves) that the current-induced STT can be employed to induce magnetization reversal [3, 4] and magnetic oscillation [5], with the former discovery gave birth to the so-called STT-MRAM industry around the world. On the other hand, the spin Hall effect (SHE) [6, 7] from certain transition metals (Pt, Ta, and W), which describes the creation of a transverse spin current via spin-orbit interaction by applying a longitudinal charge current, is shown to be efficient enough to drive magnetic reversal [8, 9] and magnetic oscillation [10, 11] in the adjacent ferromagnetic layer through STT scenario. However, unlike the STT in conventional spin valves, which is mainly dominated by the “damping-like” torque, the SHE-induced STT in magnetic heterostructures consists of both a damping-like component and a comparable “field-like” component in certain cases. In this talk I’ll present our recent endeavor on unveiling the nature of these two “spin-orbit” torques from magnetic heterostructures with DC (magnetic switching), AC (2nd harmonic voltages), and RF (spin-torque ferromagnetic resonance) probing techniques.

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