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Dynamic magnetization switching and spin wave excitations by voltage-induced torque[1]

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The effect of electric fields on ultrathin ferromagnetic metal layer is one of the promising approaches for manipulating the spin direction with low-energy consumption, localization, and coherent behavior. Several experimental approaches to realize it have been investigated using ferromagnetic semiconductors [1], magnetostriction together with piezo-electric materials [2], multiferroic materials [3], and ultrathin ferromagnetic layer [4-9]. In this talk, we will present a dynamic control of spins by voltage-induced torque. We used the magnetic tunnel junctions with ultrathin ferromagnetic layer, which shows voltage-induced perpendicular magnetic anisotropy change. By applying the voltage to the junction, the magnetic easy-axis in the ultrathin ferromagnetic layer changes from in-plane to out-of-plane, which causes a precession of the spins. This precession resulted in a two-way toggle switching by determining an appropriate pulse length [8]. On the other hand, an application of rf-voltage causes an excitation of a uniform spin-wave [9]. Since the precession of spin associates with an oscillation in the resistance of the junction, the applied rf-signal is rectified and produces a dc-voltage. From the spectrum of the dc-voltage as a function of frequency, we could estimate the voltage-induced torque.

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