Spinmechatronics using $Y_3Fe_5O_{12}$ cantilever

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In the field of spintronics, the angular-momentum-conversion between spin and mechanical rotation motion is attracting interests [1]. We report the recent progress of our studies about the spin-mechanical conversion in micro-cantilever devices consisting of ferrimagnetic yttrium iron garnet $Y_3Fe_5O_{12}$ (YIG), which were fabricated by a focused ion-beam etching method.

Firstly, we performed characterization of our YIG cantilever and found that resonance frequency of it can be controlled by a dc-magnetic field [2]. This behavior is explained by changing restoring force of the cantilever induced by a stray field from the adjacent YIG area.

Next, we pursue to observe the spin-mechanical conversion of pure spin currents. We employed the spin Seebeck effect (SSE) to generate pure spin currents. Applying a current through a heater formed at the root of an YIG cantilever, we injected a spin-Seebeck spin current into the cantilever. To eliminate other heating effects, the cantilever motion was measured by heterodyne detection technique, and we detected cantilever-oscillation signals characterized by mechanical torque due to spin relaxation. The signal disappeared by a spin-current blocking layer made at the root of the cantilever resulting that the signal stems from spin current injection. The spin-mechanical conversion is also confirmed by a theoretical analysis and field-angle dependence [3].

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