Controlling antiferromagnetic resonances

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In antiferromagnetic spintronics where manipulation of the antiferromagnetic spins is a central technological challenge[1)], it is important to understand the dynamic properties, especially their THz spin dynamics and the magnetic damping. While both experimental and theoretical investigations of the antiferromagnetic resonance began in 1950s[2)], they have been recently revisited with more advanced experimental techniques[3,4)] as well as with more rigorous theoretical treatments[5)] in the context of emerging antiferromagnetic spintronics. In the early stage of the investigations, the state-of-art spectroscopy with a rather inefficient and weak far-infrared source[1)] was employed to investigate various antiferromagnets, such as NiO, CoO, MnO, and Cr_2O_3. Although their high resonant frequencies have been experimentally confirmed, the experimental technique at the time was not sufficiently sensitive to withstand detail analyses of the spin dynamics and the magnetic damping. Moreover, importance of the magnetic damping in antiferromagnet was not seriously argued. However, thanks to the recent development of the THz technologies, frequency-domain THz spectroscopies with much better sensitivity than before has now became accessible and affordable for investigating in more detail the spin dynamics in antiferromagnets.

The talk will be based on our recent results on (1) frequency-domain THz spectroscopies of antiferromagnetic NiO and the detail analysis of the antiferromagnetic damping[6)], (2) observation of the THz spin pumping effect in NiO/Pt and NiO/Pd[7)], and (3) control of the antiferromagnetic resonance properties by cation substations of NiO[8)].

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