Ultrafast dynamics of the Electronic Ferroelectric Iron Oxide

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$LuFe_2O_4$ is a two dimensional iron oxide which consists of the alternate stack of the layer of Lu and O (R-layer) and two layers of Fe and O (W-layer). In this material, Fe^{2+} and Fe^{3+} exhibit real space ordering in the W-layer and Ikeda *et al*. proposed that $LuFe_2O_4$ could be viewed as *electronic ferroelectrics*[1], in which ferroelectricity can be caused by the ordering of the electrons in the iron cations.

Very recently, we have succeeded in observing the second harmonic generation (SHG) signal reflecting the crystal symmetry, indicating a direct evidence of the breaking of the inversion symmetry of $LuFe_2O_4$[2]. In this work, we considered the SHG signal as an index of degree of the polarity in $LuFe_2O_4$, and investigated the photoexcited state and the dynamics by pump-probe SHG measurement. For the photoexcitation, we chose two fs pulses; one is 800 nm pulse that can excite interatomic *d-d* transition and the other terahertz (THz) pulse with an electric field of about 100 kV/cm. We can expect that the former can disturb the charge order that is an origin of the electronic ferroelectrics, and the latter electrically modulates the polarization by the strong electric field. In this presentation, we will talk about how those different excitations give birth to novel photoexcited state in the electronic ferroelectrics $LuFe_2O_4$.

References:

[1] N. Ikeda *et al.*, *Nature* **436**, 1136 (2005).
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