NICPB Science Seminar

NICPB, Akadeemia tee 23, seminar room 109

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Yuto Kinoshita

Department of Advanced Materials Science, The University of Tokyo

Terahertz radiation from ferroic materials and visualization of domain structures

Recently, it has been found that magnetic materials universally show ferroelectricity, and they have been studied intensively from perspectives of controlling the ferroelectric polarization by magnetic fields and the magnetization by electric fields. To understand characteristics of ferroelectricity, magnetism, and optics in multiferroics and control them, it is necessary to visualize their unique domain structures and clarify their dynamics driven by external fields. In this study, we focused on terahertz radiation induced by femtosecond laser pulses as the method to visualize domain structures. This method has several advantages: phase sensitive, bulk sensitive, and non-destructive. As for visualization of ferroelectric domains, it is well known to use Second harmonic generation (SHG). However, only intensity can be distinguished in this method. Also, it is difficult to get the bulk information because the coherent length is usually several hundred nm. On the other hand, we can easily distinguish the phase of the ferroelectric polarization by using terahertz radiation. Furthermore, it is bulk sensitive because of the long coherent length of several hundred μm. Besides, it has another big advantage that it can determine the vector components of the ferroelectric polarization by analyzing the polarization of terahertz waves. Also, terahertz radiation from ferromagnets was reported in recent years [1]. It can be expected to visualize magnetic domains using terahertz radiation but no one has ever reported that. In this study, to realize visualization of magnetoelectric domains, we purposed to observe terahertz radiation from ferroelectrics and ferromagnets by irradiation with femtosecond laser pulses and to visualize ferroelectric and ferromagnetic domains using terahertz radiation.

In my presentation, I'll talk about terahertz radiation as back ground at first. Next, I'd like to discuss the results of terahertz radiation from ferroelectric $BiFeO_3$ and ferrimagnetic $LiFe_5O_8$ and observation of their domain structures using terahertz radiation. Finally, I'd like to talk about what I hope to do here.

[1] E. Beaurepaire *et al*., *Appl. Phys. Lett.* **84**, 3465 (2004).