Investigation on Magneto-optical Properties of Epitaxial-stabilized Hexagonal *R*MnO_3 (*R*=Dy, Tb, Gd) Thin Films

Woo Seok Choi, Soon Jae Moon, Sun Jung Kim, Daesu Lee, Jung Hyuk Lee, Tae Won Noh (ReCOE & FPRD, Department of Physics and Astronomy, Seoul National University, Seoul 151-747, Korea)

Introduction

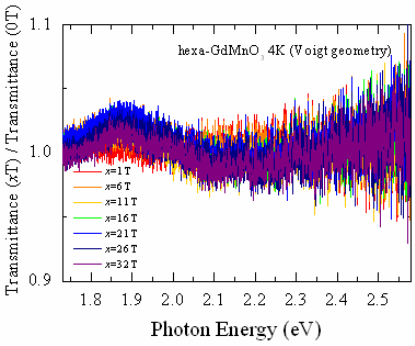
Recently, *R*MnO_3 (*R* = Dy, Tb, Gd, and Ho) have been successfully fabricated into hexagonal thin film phase using the epitaxial stabilization technique [1]. These materials show multiferroic behavior with fairly large values of electric polarization and Curie temperature. We investigated optical properties of the hexagonal *R*MnO_3 (*R* = Dy, Tb, Gd, and Ho) under high magnetic field.

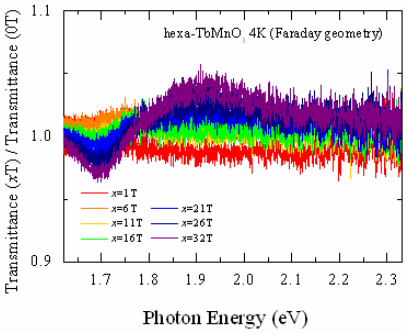
Experimental

We measured optical transmittance of hexagonal *R*MnO_3 (*R* = Tb, Gd) between 1.73 eV and 2.58 eV using optical cables and a grating spectrometer. We swept the magnetic field between 0 T and 32.5 T using a resistive magnet. We applied two different types of geometry (Voigt and Faraday) for the magnetic field.

Results and Discussion

The optical transmittance spectra show systematic changes as we apply external magnetic field. As in the figures below, the transmittance increases or decreases up to 5% as we apply the magnetic field. The change mainly occurs at 1.7 eV for $TbMnO_3$ and 1.85 eV for $GdMnO_3$, which corresponds to an inter-site optical transition in these materials. The change of electronic structure by varying the magnetic structure might be a clue for the magnetoelectric coupling in these materials.





Conclusions

We measured the magneto-optical properties of hexagonal $TbMnO_3$ and $GdMnO_3$ thin films. Optical transmittance spectra changed almost 5% when 32 Tesla of magnetic field was applied. This indicates that the electronic structure of hexagonal *R*MnO_3 is changing when the magnetic structure is varied.

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References

[1] J. H. Lee *et al*., Adv. Mat., **18**, 3125 (2006).