Time-Resolved Magneto-Optical Kerr Effect for Ultrafast Thermal Characterization

J. Zhu[1], D.M. Lattery[1], D.L. Zhang[2], J.Y. Chen[2], M. Li[2], J.-P. Wang[2], and X.J. Wang[1]

[1]*Department of Mechanical Engineering, University of Minnesota, Minneapolis, MN 55455, USA*
[2]*Department of Electrical and Computer Engineering, University of Minnesota, Minneapolis, MN 55455, USA*

Thermo-magnetic and magneto-optical effects are two fundamental but unique phenomena existing in magnetic materials. In this talk, we demonstrate ultrafast time-resolved magneto-optical Kerr effect (TR-MOKE) as an advanced technique for studying the anisotropic thermal transport in black phosphorus with the enhanced measurement sensitivity and signal-to-noise ratio. We further reveal the original factors of MOKE signals, which are related to the temperature-dependent magnetization and Kerr rotation angle at the saturated magnetization state of magnetic transducers. Among four magnetic transducers studied, we identify the rare-earth transition metal-based TbFe and GdFeCo alloys provide the best enhancement of TR-MOKE measurement signals.

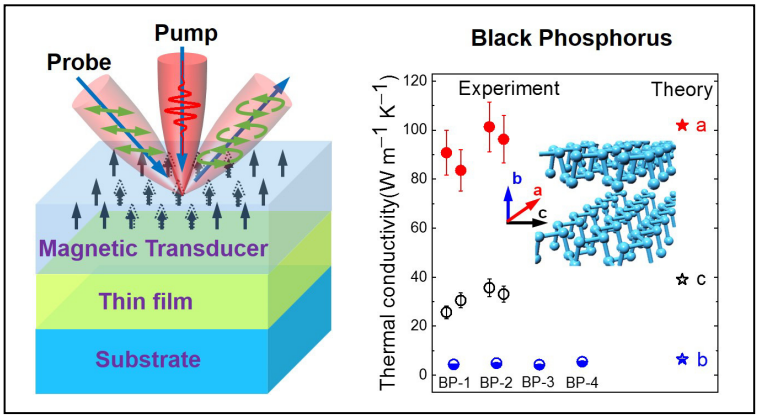

Fig. 1: Schematic of TR-MOKE measurement mechanisms (left) and anisotropic thermal conductivities of black phosphorus measured with TR-MOKE along three primary crystalline directions (right). The coordinates of *a*, *b*, and *c* correspond to the in-plane zigzag, through-plane, and in-plane armchair directions of black phosphorus, respectively.

[1] J. Zhu, H. Park, J.Y. Chen, X.K. Gu, H. Zhang, S. Karthikeyan, N. Wendel, S. Campbell, M. Dawber, D. Xu, M. Li, J.P. Wang, R.G. Yang, and X.J. Wang, *Adv. Electron. Mater.* **2**, 1600040 (2016).

[2] J.Y. Chen, J. Zhu, D.L. Zhang, D. Lattery, M. Li, J.P. Wang, and X.J. Wang, *J. Phys. Chem. Lett.* **7**(13), 2328-2332 (2016).