

## Ultrafast Dynamic Study of MBE Growth Bi-Topological Insulator

*Jin-Wei Li<sup>1</sup>, Hsuan-Yin Chen<sup>1</sup>, Che-Wei Huang<sup>1</sup>, J.C.A. Huang<sup>2</sup> and \*Chao-Kuei Lee<sup>1,3</sup>*

*<sup>1</sup>Department of Photonics, National Sun Yat-sen University, Kaohsiung 804, Taiwan.*

*<sup>2</sup>Department of Physics, National Cheng Kung University, Tainan, Taiwan.*

*<sup>3</sup>Department of Physics, National Sun Yat-sen University, Kaohsiung 80411, Taiwan*

*E-mail: \*chuckcklee@yahoo.com*

Topological insulators have been attracted lots of attentions due to their potential in spintronics which is attributed to special surface state from strong spin orbital interaction. To date, plenty of researches about topological insulators have been reported. However, most investigations focus on physical properties of single crystals. As a result, studies in detail to topological insulator thin film, such as grown by molecular beam epitaxy (MBE), are very important problems and in an urgent need.

In this work, we investigate the coherent phonon properties within the  $\text{Bi}_2\text{Se}_3$  and  $\text{Bi}_2\text{Te}_3$  films. Using Optical Pump Optical Probe Transmitted spectroscopy (OPOPT), the oscillation phenomenon was observed within the pump probe profile. This can be attribute to coherent phonon which has been discussed theoretically and predicted that the coherent phonon will be un-exist for topological insulator with thickness less than 20nm for  $\text{Bi}_2\text{Te}_3$  [1] and 40nm for  $\text{Bi}_2\text{Se}_3$  [2], respectively.

To confirm the conclusion from typical reflective pump probe measurement, a new type of reflective pump probe which the pump and probe beam excite the film on the opposite side was buildup. The result indicated the nature of phonon propagation. Furthermore, thickness dependent of phonon life time and relaxation time are also discussed.

[1] Yaguo Wang, Liang Guo, and Xianfan Xu, Origin of coherent phonons in  $\text{Bi}_2\text{Te}_3$  excited by ultrafast laser pulses, Phys. Rev. B, 88, 064307 (2013).

[2] Yuri D. Glinka, Sercan Babakiray, Trent A. Johnson, Alan D. Bristow, Mikel B. Holcomb et al., Ultrafast carrier dynamics in thin-films of the topological insulator  $\text{Bi}_2\text{Se}_3$ , Appl. Phys. Lett. 103, 151903 (2013).