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Ultrafast dynamics in quantum matter, THz spectroscopy, Femtosecond laser annealing & machining

We are “Ultrafast dynamics Lab” (Figure 1) of the Electrophysics Department, NCTU. Our primary research interests include the following three major parts: **(a) Ultrafast dynamics in quantum matter:** We have developed all-around pump-probe techniques and tools to investigate different quantum matter. For example, the ultrafast dynamics of monolayer MoS₂ has been studied using the OPA pump and supercontinuum white light probe helicity-resolved spectroscopy, which would play a crucial role in various applications including spintronics, valleytronics, and semiconductor devices (Figure 2). **(b) THz spectroscopy:** The time-domain measurements of THz radiation generated from topological insulators (TIs) can be performed by ultrafast optical pulse excitation. The present study demonstrates that time-domain THz spectroscopy provides rich information of the optical coupling and the electronic structure of TIs (Figure 3). **(c) Femtosecond (fs) laser annealing and machining:** Due to the high peak power of femtosecond laser pulses, we have established a laser micromachining and annealing system. The properties of materials could be modified easily in very short period, such as the surface morphology, carrier concentration, carrier mobility, etc. (Figure 4). **Key Facilities:** Pump-probe spectrometer, Low-temperature cryostat, Fourier transform infrared (FTIR) spectrometer, ultrashort-pulse optical parametric amplifier (OPA), and several other critical equipment necessary in the studies of ultrafast optics.

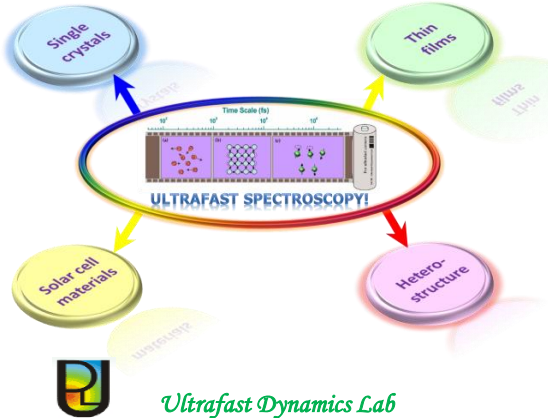


Figure 1

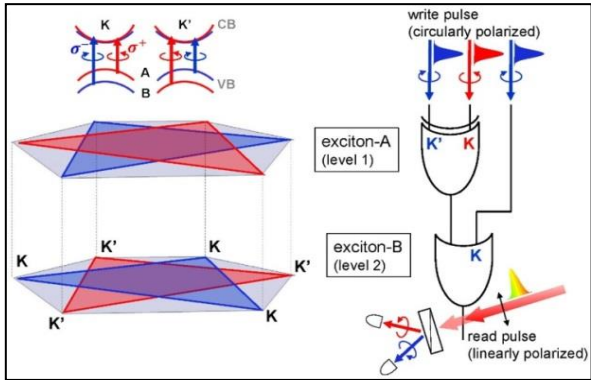


Figure 2

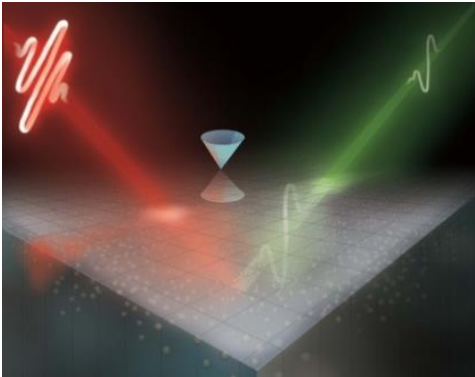


Figure 3

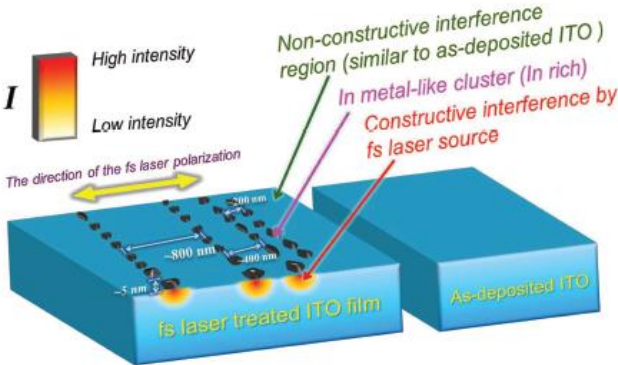


Figure 4