

TeraHertz Pump TeraHertz Probe (TPTP) Experiment on Metal-Insulator Transition in a Mott Insulator: VO₂

Context

Mott insulators are a family of strongly correlated materials for which the metal-insulator transitions (MIT) mechanism differs from usual ones. To explore the phase diagrams of such materials, one would either use a cryostat or change the pressure (either chemically or mechanically). THz light is expected to change the pressure inside the cells and could therefore trigger the MIT, this can also be explained by moving in the phase diagram horizontally (see Figure 1). THz light is also sensitive to the conductivity in materials, which would change with the MIT. Therefore, a THz Pump THz probe experimental (TPTP) scheme would be a good way to both probe and induce this phase transition.

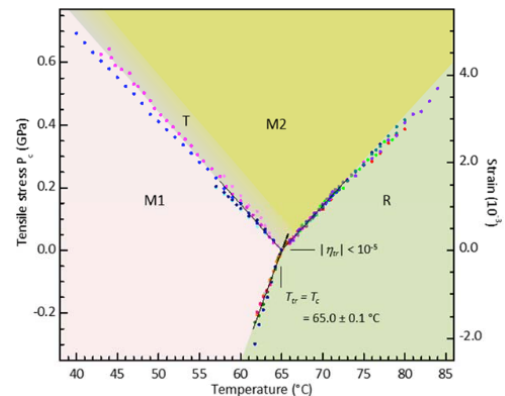


Figure 1 : Phase diagram of VO₂ adapted from [1]

Spintronic emitters present a very quick recombination time of a few 10 of fs. Thanks to this recombination time, it would be possible to generate two THz pulse in quick succession using two colinear optical pulses. The intensity of the THz pulses would be directly linked to the power of the optical pulses allowing to realize a simple TPTP experiment.

Work program & Skills acquired during internship

This project is jointly proposed by CROMA and LMGP research laboratories affiliated with Univ. Grenoble Alpes, Grenoble INP-UGA, USMB and CNRS. The objective is to implement and realize the TPTP experiment as well as producing thin films of VO₂ samples. The TPTP experiment would be realized in the CROMA laboratory and the thin films generations would be made in the LMGP laboratory. The intern student will develop various complementary skills that will help her or him in the full characterization of materials by a large variety of techniques both dynamic and static.

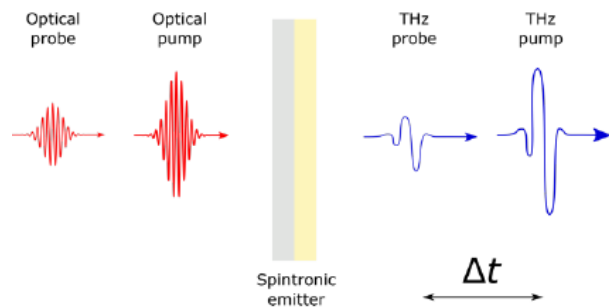


Figure 2: TPTP scheme using spintronic emitter

Contact : pierre-baptiste.vigneron@univ-smb.fr

Jean-Luc.Deschanvres@grenoble-inp.fr

References :

- [1] Park, J. H., Coy, J. M., Kasirga, T. S., Huang, C., Fei, Z., Hunter, S., & Cobden, D. H. (2013). Measurement of a solid-state triple point at the metal-insulator transition in VO₂. *Nature*, 500(7463), 431-434.
- [2] T. Seifert et al., "Efficient metallic spintronic emitters of ultrabroadband terahertz radiation," *Nat Photonics*, May 2016.