Contribution ID: **45** Type: **Poster**

Charge transport in semiconductor nanostructures investigated by terahertz spectroscopy

Tuesday, 24 July 2012 20:00 (2 hours)

H. Němec, Z. Mics, and P. Kužel
Institute of Physics AS CR, Na Slovance 2, 18221 Praha, Czech Republic

The optical pump—THz probe spectroscopy provides a sub-picosecond time resolution and a convenient access to the spectral part of the conductivity spectra where the responses of free and localized charge carriers usually fundamentally differ. We developed a microscopic model of far-infrared conductivity, which comprises two contributions: the contribution of local (depolarization) fields (accounted for by Maxwell-Garnett or Bruggeman effective medium model) and that directly related to the localization of charge carriers [1]. We employ a Monte Carlo method to simulate the carrier motion within nanoparticles and, subsequently, we use the Kubo formula to calculate the far-infrared conductivity. The character of the complex conductivity spectrum is essentially determined by the probability of the inter-particle transport of carriers and by the ratio of the nanoparticle size and the bulk carrier mean free path.
We demonstrate our approach on the interpretation of experimental results we obtained with CdS nanoparticles with various sizes [2]. We found that a certain confinement of photogenerated electrons exists, but there is a strong coupling and percolation between adjacent nanocrystals which permits an efficient inter-nanocrystal transport. We also found that electron mobility strongly depends on carrier excess energy. Low mobility is observed for carriers with low excess energy (after excess energy relaxes at low excitation densities), since these charges are localized between potential barriers. When the excess energy is high, the mobility is also high as charge carriers can easily pass over potential barriers. This happens either immediately after photoexcitation of charges with short-wavelength radiation, or in the case of high excitation densities when quasi-Fermi energy is high above the conduction band minimum.

[1] H. Němec et al., J. Photochem. Photobiol. A 215, 123 (2010).
[2] Z. Mics et al., Phys. Rev. B 83, 15 5326 (2011).

Primary author: NEMEC, Hynek (Institute of Physics AS CR, Na Slovance 2, 18221 Praha, Czech Republic)

Presenter: NEMEC, Hynek (Institute of Physics AS CR, Na Slovance 2, 18221 Praha, Czech Republic)

Session Classification: Poster Session 2

Track Classification: Photoinduced Studies