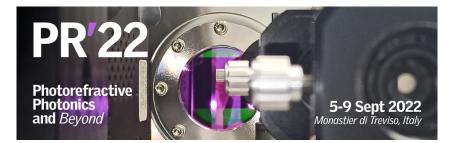
Photorefractive Photonics and Beyond



Contribution ID: 49

Type: Poster

Electronic balls and photonic clubs in photogalvanic lithium niobate: a first principles approach

Thursday 8 September 2022 16:40 (1h 30m)

The photogalvanic effect (PGE) consists in the spontaneous production of a bulk electrical current density in a polar material when the latter is illuminated [1]. This effect triggers several phenomena which are at the basis of important applications such as photorefraction, photovoltaic energy conversion in photoferroelectrics, photocatalysis and so on [2,3,4].

Despite the fact that a microscopic understanding of the PGE is nowadays quite achieved, it still relies on a few phenomenological parameters. In particular the thermalization length, describing the absolute average distance from the emitting site at which a photo-excited charge self-localizes into a polaron, cannot be obtained from experiments and at the same time it is the critical parameter ruling the photogalvanic properties of a given material.

In this work we present a mean-field approach [5] to describe the energy loss of the photoemitted charge interacting with the phonon bath of the material, which allows us to compute the thermalization length. Our results are applied to the technologically important case of lithium niobate [6]. Using our method we can reproduce the wavelength dependence of the PGE and compare the obtained results with experimental data [7].

[1] Fridkin, V. M. "Bulk photovoltaic effect in noncentrosymmetric crystals." Crystallography Reports 46.4 (2001): 654-658.

[2] Glass, Alastair M. Photorefractive materials and their applications. Eds. Peter Günter, and Jean-Pierre Huignard. Vol. 1. Berlin: Springer, 1988.

[3] Tan, Liang Z., et al. "Shift current bulk photovoltaic effect in polar materials—hybrid and oxide perovskites and beyond." Npj Computational Materials 2.1 (2016): 1-12.

[4] Fang, Liang, Lu You, and Jun-Ming Liu. "Ferroelectrics in Photocatalysis." Ferroelectric Materials for Energy Applications (2018): 265-309.

[5] NPJ Com. Mat. (Accepted)

[6] Schirmer, O. F., M. Imlau, and C. Merschjann. "Bulk photovoltaic effect of LiNbO 3: Fe and its small-polaron-based microscopic interpretation." Physical Review B 83.16 (2011): 165106.

[7] Grousson, R., et al. "Measurement of bulk photovoltaic and photorefractive characteristics of iron doped LiNbO3." Journal of applied physics 54.6 (1983): 3012-3016.

Authors: Dr FAVARO, Giulio (University of Padova); Prof. UMARI, Paolo (University of Padova); BAZZAN, Marco (University of Padova and INFN)

Presenter: BAZZAN, Marco (University of Padova and INFN)

Session Classification: Poster session - in presence

Track Classification: Fundamentals of charge and exciton generation and transport