Polarons and Polarons in oxides: recent developments

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In this talk, an overview of polaron physics is presented with attention for recent results, both experimental and theoretical. I start from the general introduction to the polaron concept, continuing with the kinetic and optical response of polarons and many-polaron systems. Some techniques used in polaron theory are reviewed and manifestations of polarons in doped oxides, such as strontium titanate are discussed. In particular recent experimental and theoretical results on the polaron optical and DC response in strontium titanate are addressed. Experimental data [1] on the optical conductivity of niobium doped SrTiO3 are interpreted in terms of a gas of large polarons [2]. The theoretical approach takes into account many-body effects, the electron-phonon interaction with multiple LO-phonon branches, and the degeneracy and the anisotropy of the conduction band. It will be shown that the many-polaron optical conductivity spectra, calculated within the large-polaron picture without adjustment of material constants, explain the essential characteristics of the experimental optical conductivity. The large-polaron model gives a meaningful -if not perfect- interpretation of the experimentally observed optical conductivity spectra of SrTi1□xNbxO3. The possible role of 'small' polarons in the optical response of the Nb-doped strontium titanate is briefly discussed.

[1] J. L. M. van Mechelen, D. van der Marel, C. Grimaldi, A. B. Kuzmenko, N. P. Armitage, N. Reyren, H. Hagemann, and I. I. Mazin, Phys. Rev. Lett. 100, 226403 (2008).

[2] J. T. Devreese, S. N. Klimin, J. L. M. van Mechelen, and D. van der Marel, Phys. Rev. B 81, 125119 (2010).