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Gigantic transverse dielectric screening in Quasi-2D materials

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The electrical and optical properties of quasi-two-dimensional (Q2D) materials are predominantly known within their macroscopic in-plane dimensions. In the latter regime, the strictly 2D models, neglecting the finite thickness of the systems, serve, in most cases, as already a satisfactory approximation to study the corresponding phenomena. Here, on the contrary, we explore the reaction of the Q2D materials to the static and dynamic electric fields applied perpendicularly to the systems' layer(s), when finite, although microscopic, transverse extent of the system plays a defining role. Counter-intuitively, in spite of the robustness of the inter-atomic bonds, we discover the full or almost full screening of the external field in the interior of the Q2D crystals. The dramatic effect of these findings on the photoemission spectroscopy of the Q2D materials is revealed and discussed, leading, in particular to the failure of the conventional dipole theory of photoemission for these systems. In order to better understand the underlying physical processes, we introduce the Q2D jellium model which qualitatively reproduces results of our Ab initio calculations.

Speaker Biography

Vladimir U Nazarov completed his Ph.D in physics and currently an associate research fellow at the Research Center for Applied Sciences, Academia Sinica, Taiwan. His research focuses on the fundamentals of Time-Dependent Density-Functional Theory (TDDFT) and its applications to optics and transport in bulk materials and low-dimensional structures. He has his habilitation (in Russia, Doctor of Physical and Mathematical Sciences) from the Far-Eastern National University, Russia. The past positions of him include the Leading researcher at the Institute for Automation, Far-Eastern Branch of Russian Academy of Sciences, associate professor at Kyushu Institute of Technology, Japan, visiting professor at the Institute for Solid State Physics, Japan, and visiting professor at Chonnam National University, South Korea.

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