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Features of light coupling in low-loss 2D periodic structures supporting phonon polariton

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Understanding of light-matter interaction in a wide frequency range is an important fundamental problem with significant potential applied impacts. For instance, Plasmonics is a rapidly developing field at the boundary of physical optics and condensed matter physics with many prospective applications. However, the use of plasmons is limited from a practical point of view because their spectral signature is in the visible and near infrared region, where metals have strong absorption leading to high losses. From this point of view, the use of low-loss materials, like polar dielectrics, is promising. Particularly, in such materials surface phonon polaritons can be easily excited from the infrared to the terahertz frequencies resulting in a strong coupling of light and optical phonons in the crystal.
In this report, we studied features of light localization in low loss 2D periodic structures formed by a polar crystal. Specifically, we considered a periodic structure of silicon carbide nanodisks on a crystalline silicon substrate. We numerically solved Maxwell equations with appropriate boundary conditions. The strong dependence of phonon polariton spectral resonances with the period of the array was theoretically revealed. Furthermore, experimental reflectivity measurements on the fabricated structure confirmed these tendencies.

Primary authors: MANKOVSKA, Yuliia (Taras Shevchenko National University of Kyiv); ISAEV, Mykola (Faculty of Physics, Taras Shevchenko National University of Kyiv; 2LEMTA, CNRS-UMR7563, Université de Lorraine, Vandoeuvre les Nancy F-54500, France); BELAROUCI, Ali (Université de Lyon; Institut des Nanotechnologies de Lyon, UMR-5270, site Ecole Centrale de Lyon, Ecully, France)

Presenter: MANKOVSKA, Yuliia (Taras Shevchenko National University of Kyiv)

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