Structured Materials for Strong Light-Matter Interactions

IRG-2

The goal of this newly proposed IRG is to understand, create, and harness exceptionally strong lightmatter interactions for scientific discoveries and future photonic information processing technologies. To date, optical information processing has been limited by typically weak photonphoton interactions; this IRG aims to generate orders-of-magnitude enhancements in light-matter interactions, and hence light-light coupling mediated by these interactions. Our strategy is to unite materials and photonics expertise to develop new "structured materials," consisting of thin-film heterostructures designed to provide unique optical properties which are then sculpted – sometimes in non-intuitive ways – to control light-matter interactions down to the nanoscale. If successful, this research will enable new, small-footprint optical information- processing platforms capable of operating at high speeds, with extremely high efficiency, at low power, and in some cases, in advanced quantum technologies.

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IRG HIGHLIGHTS

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IRG NOTABLE PUBLICATIONS BELOW

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Notable Publications

IRG-2 Structured Materials for Strong Light-Matter Interactions

Guru Khalsa, Nicole A. Benedek, and Jeffrey Moses, "Ultrafast Control of Material Optical Properties via the Infrared Resonant Raman Effect", Phys. Rev. X 11, 021067 (2021).

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Kevin Lee, Yongjin Cho, Leo J. Schowalter, Masato Toita, Huili Grace Xing, and Debdeep Jena, "Surface control of single crystal Al-polar AlN during cleaning and homoepitaxy by plasma-assisted molecular beam epitaxy," Appl. Phys. Lett. 116, 262102 (2020) Editor's Pick

Kevin Lee, Ryan Page, Vladimir Protasenko, Leo J. Schowalter, Masato Toita, Huili Grace Xing and Debdeep Jena, "MBE growth and donor doping of coherent ultrawide bandgap AlGaN alloy layers on single-crystal aluminum nitride substrates," Appl. Phys. Lett. 118, 092101 (2021) Editor's Pick

Jiaoyang Zheng, Guru Khalsa, Nicole A. Benedek, and Jeffrey Moses, "Two-pulse enabled coherent control of structural dynamics", International Conference on Ultrafast Phenomena 2022, Montreal, Canada, July 18 – 22, 2022.

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Jiaoyang Zheng, Guru Khalsa, Nicole A. Benedek, and Jeffrey Moses, "Distinguishing the Nonlinear Polarizability From the Anharmonic Lattice Potential by Two-Dimensional Terahertz Spectroscopy for Nonlinear Phononics", Ultrafast Phenomena in Cooperative Systems, Gordon Research Conference, Ventura California, Oct 9 - 14, 2022.

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