nanoX invited scientist

Nicolas Large

Position Assistant Professor

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Host lab at NanoX CEMES Team Nano-Optics and Nanomaterials for Optics (NeO)

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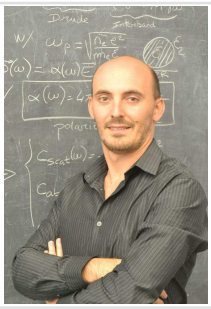
Dates of stay March 1 - April 30, 2022



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Brief Biodata

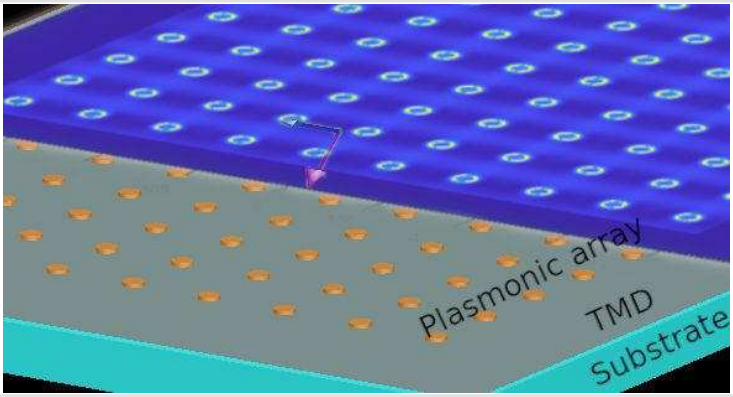
Dr. Nicolas Large is an Assistant Professor of Physics at the University of Texas at San Antonio (UTSA). He obtained a dual PhD in 2011 in Nanophysics from Paul Sabatier University of Toulouse and in Physics of Nanostructures and Advanced Materials from the University of the Basque Country in San Sebastián, Spain under the supervision of Drs. J. Aizpurua and A. Mlayah. Later, he worked as a postdoctoral researcher with Dr. P. Nordlander at Rice University in Houston (2012-2014), and with Dr. G.C. Schatz at Northwestern University in Chicago (2014-2016). He is currently conducting research in the field of theoretical nanophotonics and focuses on the modeling of the optical and photothermal properties of semiconducting, plasmonic, dielectric, and hybrid nanostructures.

Research project during the visit at nanoX

Computational Modeling of the Thermo-Optical and Photothermal Properties of Hybrid Plasmonic-Excitonic Nanostructures

Multifunctional nanomaterials are of high interest to a wide range of technological applications ranging from optoelectronics to biomedicine, energy, sustainability, photonic devices, and applied chemistry. In order to develop multifunctional nanomaterials capable of addressing specific functions for targeted applications, it is crucial to first understand the fundamental physical properties and mechanisms involved in such complex nanostructures. Well known examples are low-dimensional excitons, sustained in low-dimensional semiconductors, and localized surface plasmon resonances (LSPRs), sustained by nanostructures composed of noble metals, which are two types of collective electronic excitations whose spectra are in the visible range. Over recent years, the nanophotonics community has become very interested in studying resonant optical phenomena arising from the interaction between plasmons and excitons that occurs in hybrid metal-semiconductor nanostructures. It has been established that coherent coupling between plasmons and excitons gives rise to new optical elementary excitations named plexcitons. Here, we propose to theoretically investigate the effect of photothermal heating induced by the optical excitation of the LSPs in the metal on the optical properties of metal-semiconductor hybrid nanostructures and, more specifically on the plasmon-exciton coupling itself. In particular, we will focus on systems composed of a nanostructured plasmonic substrate (2D periodic arrangement of plasmonic nanoparticles (NPs)) with transition metal dichalcogenides (TMDs) monolayers deposited on top. Ultimately, this project aims to expand the fundamental knowledge of the optical, photothermal, and thermo-optical properties of plasmonic-excitonic (plexcitonic) nanomaterials.

If relevant, add a figure



Local electric field enhancement calculated in the TMD layer of a hybrid plasmonic-excitonic (Au-MoSe2) periodic array when optically excited at the localized surface plasmon resonance (LSPR).