NANOPHOTONICS TECHNOLOGY CENTER

Description of the group

The "Plasmonics and Optomechanics" group is one of the seven research groups within the Nanophotonics Technology Center of the Universitat Politècnica de València. This group is led by Prof. Alejandro Martínez and involves two post-docs, four PhD students and several master students. The group is gender-balanced, being currently formed by female researchers at about 50%.

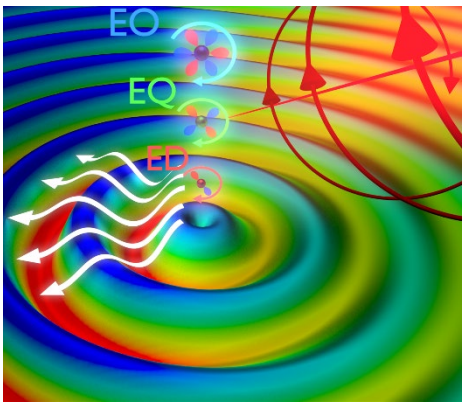
The main interest of this group is to develop new nanophotonic devices to be integrated in silicon photonic integrated circuits for applications in telecom systems and biosensing.

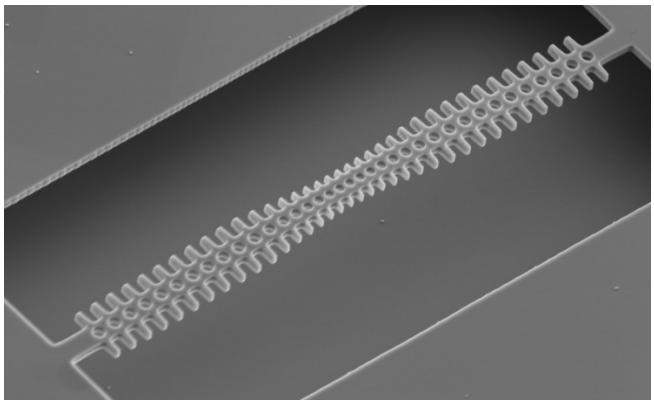
We are interested in using plasmonic nanostructures - made of metals - for overcoming the diffraction limit and achieve light manipulation at subwavelength scales. Such extreme light squeezing is interesting to get ultra-compact and highly efficient devices.

But not only plasmonic nanostructures can improve the performance of current state-of-the-art silicon photonic chips. Recently, optomechanics has revealed itself as a research hot-topic since it provides the adequate mechanisms to make light and sound interact at the nanoscale. In our group we deal with optomechanical cavities built on silicon chips to manipulate GHz vibrations optically with the final aim of getting ultra-compact microwave photonic circuitry on silicon as well as hybrid ultra-sensitive biosensors.

We are also addressing the enhanced integration of vibrational resonances of matter at THz frequencies using plasmonics, being at the forefront of the discipline termed molecular optomechanics.

We are convinced that in future nanophotonic chips light will to interact with free-electrons in metals (via plasmons) as well as with mechanical vibrations (in suspended nanostructures via optomechanical forces). Therefore, the integration of plasmonic and optomechanical components onto silicon-photonics chips is a key step towards future nanophotonic chips, which is a goal pursued in our group.





Selected publications

1. Laura Mercadé, Leopoldo L. Martín, Amadeu Griol, Daniel Navarro-Urrios, Alejandro Martínez, "Microwave generation and frequency comb in a silicon optomechanical cavity with a full phononic bandgap," Nanophotonics 9, 3535 (2020).
2. M. F. Colombano, G. Arregui, N. E. Capuj, A. Pitanti, J. Maire, A. Griol, B. Garrido, A. Martinez, C. M. Sotomayor-Torres, D. Navarro-Urrios, "Synchronization of optomechanical cavities by mechanical interaction," Phys. Rev. Lett., 123, 017402 (2019)
3. Alejandro Martínez, "Polarimetry enabled by nanophotonics," Science 362, 750 (2018).
4. J. Enrique Vázquez-Lozano, Alejandro Martínez, "Optical Chirality in Dispersive and Lossy Media," Phys. Rev. Lett. 121, 043901 (2018). Highlighted as Editors´ Suggestion.
5. A. Espinosa-Soria , E. Pinilla-Cienfuegos, F. J. Díaz-Fernández, A. Griol, J. Martí, and A. Martínez, "Coherent Control of a Plasmonic Nanoantenna Integrated on a Silicon Chip," ACS Photon. 5, 2712−2717 (2018).
6. Alba Espinosa-Soria, Francisco J. Rodríguez-Fortuño, Amadeu Griol, and Alejandro Martínez, "On-chip optimal Stokes nanopolarimetry based on spin-orbit interaction of light," Nano Lett. 17, 3139-3144 (2017).
7. D. Navarro-Urrios, N. E. Capuj, M. F. Colombano, P. D. Garcia, M. Sledzinska, F. Alzina, A. Griol, A. Martinez, C. M. Sotomayor-Torres, "Nonlinear dynamics and chaos in an optomechanical beam," Nature Commun. 8, 14965 (2017).
8. F. J. Rodríguez-Fortuño, N. Engheta, A. Martínez and A. V. Zayats, "Lateral forces on circularly polarizable particles near a surface," Nature Comm. 6, 8799 (2015).
9. F. J. Rodríguez-Fortuño, I. Barber-Sanz, D. Puerto, A. Griol, A. Martinez, "Resolving light handedness with an on-chip silicon microdisk", ACS Photonics 1(9), 762–767 (2014).
10. F. J. Rodríguez-Fortuño, G. Marino, P. Ginzburg, D. O'Connor, A. Martínez, G. A. Wurtz, A. V. Zayats, "Near-Field Interference for the Unidirectional Excitation of Electromagnetic Guided Modes," Science 340, 328-330 (2013).

Recent European H2020 projects

1. PHENOMEN "All-Phononic circuits Enabled by Opto-mechanics"
2. THOR "Terahertz detection enables by molecular optomechanics"
3. SIOMO "SIlicon Optomechanical optoelectronic Microwave Oscillator"
4. SAPHER "Disruptive Nano Photonics-based bio sensing platform for simultaneous analysis of multiple allergens in food industry"

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