DEPARTMENT OF MATERIALS SCIENCE AND ENGINEERING SEMINAR

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1062 Bainer Hall

Advanced Manipulation of Electromagnetic Waves with Nanostructured Surfaces

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Abstract: The exponential expansion of the information society is continuously imposing stringent – and sometimes even contradictory – technological requirements to modern communication systems, including high communication data rates, efficient use of the spectrum, ubiquitous wireless connectivity, and many functionalities integrated into reconfigurable, miniaturized, and wearable devices. To meet such requirements, it appears today clear that novel and advanced approaches—rather than the simple optimization of existing solutions—are needed. In this talk, I will discuss the unprecedented possibilities offered by ultrathin nanostructured surfaces to overcome such limitations and exhibit exciting functionalities thanks to the use of tunable, active, and nonlinear materials and enhanced wave-matter interactions. I will first focus on graphene and other 2D materials as a powerful reconfigurable platform for THz and infrared plasmonics, describing novel components such as modulators, waveguides, and antennas as well as unusual non-reciprocal responses based on the spatio-temporal modulation of graphene’s conductivity. Then, I will present ‘hyperbolic metasurfaces’ able to exploit strong anisotropic behavior over uniaxial structures, demonstrating extreme topological transitions and a dramatic enhancement of light-matter interactions with application in imaging, hyperlensing, and communications. Next, I will introduce a ‘flat non-linear paradigm’ able to simultaneously exhibit a record high second-order nonlinear response from plasmonic metasurfaces tied to multi-quantum wells and sub-diffractive phase control. Such combination paves the way to the efficient generation of pencil-beams steered in arbitrary direction in space, vortex beams, and focusing. The last example will propose a new type of ultra-fast infrared sensor based on ultrathin nanomechanical resonators able to provide unprecedented electromechanical performance and thermal capabilities. I will finalize the talk by outlining my vision for the near and long-term future of ultrathin metasurfaces and their potential impact on society.

Biography: Juan Sebastian Gomez Diaz is an Assistant Professor in the Electrical and Computer Engineering Department of the University of California, Davis. He received his Ph.D. degree in electrical engineering (with honors) from the Technical University of Cartagena (UPCT, Spain) in 2011. From October 2011 until March 2014 he was a postdoctoral fellow at the École Polytechnique Fédéral de Lausanne (EPFL, Switzerland). Then, from May 2014 to August 2016, he continued his postdoctoral work in the Metamaterials and Plasmonic Research Laboratory of The University of Texas at Austin (US). He has co-authored 50 journal papers, some of them published in highly selective journals such as Nature Communications, Physical Review Letters, and IEEE Transactions/Letters, 60 conference papers and 1 book chapter. His main research interests include multidisciplinary areas of electromagnetic wave propagation and radiation, metamaterials and metasurfaces, plasmonics, novel 2D materials, antennas, nonlinear phenomena, and other emerging topics on applied electromagnetics and nanotechnology.