ICFO Colloquium Series: Meta-imaging of Textures and Tissues

MARK BRONGERSMA

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15:00 to 16:00
ICFO Auditorium

ABSTRACT:
Metamaterials are a new, emerging class of high-performance materials that derive their unique, physical properties from the way they are structured. In the first part of this presentation, I will focus on the creation of 2-dimensional metamaterials (i.e. metasurfaces) by nanopatterning thin layers of semiconductors and metals. I will argue that metasurfaces are ideal building blocks for next generation optical sensing and imaging technologies. I will highlight the possibility of using integrated metasurfaces to realize entirely new imaging modalities, such as the imaging of texture.
In the second part of my talk, I will explain how metamaterials concepts can be used reduce the opacity of tissue and skin due to unwanted light scattering from the refractive index mismatch among its components. Conventionally, water and/or liquids need to be removed

to make biological tissues transparent by minimizing refractive index mismatch; however, this process hinders achieving transparency in live tissues. I will discuss the counterintuitive observation that strongly absorbing molecules can achieve optical transparency in live biological tissues. I will highlight the physics behind this phenomenon and show that when strongly absorbing molecules dissolve in water to form a liquid metamaterial, they can modify its refractive index via the Kramers-Kronig relations to match that of high-index tissue components like lipids. We demonstrate that this straightforward approach can reversibly render the mouse abdominal wall transparent to allow visualization of digestive tract peristalsis and image myenteric ganglia microscopically.

PROFILE:
Mark Brongersma is the Stephen Harris Professor of Engineering at Stanford University. He leads a research team of eight students and two postdocs. Their research is directed towards the development and physical analysis of new materials and structures that find use in nanoscale electronic and photonic devices. He is on the list of Global Highly Cited Researchers (Clarivate Analytics). He received a National Science Foundation Career Award, the Walter J. Gores Award for Excellence in Teaching, the International Raymond and Beverly Sackler Prize in the Physical Sciences (Physics) for his work on plasmonics, and is a Fellow of the OSA, the SPIE, and the APS. Dr. Brongersma received his PhD from the FOM Institute AMOLF in Amsterdam, The Netherlands, in 1998. From 1998-2001 he was a postdoctoral research fellow at the California Institute of Technology.
Hosted by: Darrick Chang