All-Silicon Mid-Infrared Metasurfaces with Dual Functionality

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In the infrared spectral range, silicon is primarily known as a translucent material with dielectric behavior enabling the design of a wide variety of Photonic Integrated Circuits and Photonic MEMS, embedding interferometers, waveguides and photonic crystals. In those applications, doping is usually seen as a drawback since it introduces absorption loss, hence affecting the integrity of the dielectric properties.

In this talk, we will discuss the benefits of the synergetic effects of silicon doping and surface micro- and nano-structuration for tailoring the spectral and directional absorptivity/emissivity of silicon surfaces with potential applications as MIR coherent thermal light sources.

The resulting Mid-Infrared metasurfaces can further exhibit additional tailorable wetting functionality, which is also discussed for applications to Atmospheric Water Harvesting (AWH) taking advantage of energy-passive nigh-time radiative cooling combined with exceptionally fast water removal capabilities.

Short Bio: Prof. Tarik Bourouina has obtained his Ph.D. in 1991 and his Habilitation (HDR) in 2000 from Université Paris-Saclay. He has been Professor of Physics at ESIEE Paris, Université Gustave Eiffel since 2002. He is also affiliated to the French National Center for Scientific Research (CNRS), within the CINTRA laboratory IRL 3288 in Singapore jointly with Nanyang Technological University (NTU) and THALES, and within the ESYCOM laboratory UMR 9007 in France. Formerly, he took several positions in France and in Japan; at Université Paris-Saclay (1995-1998) as Associate Professor in IEF Lab (CNRS UMR 8622), at The University of Tokyo (1998-2001) in LIMMS Lab (CNRS UMI 2820). Dr. Bourouina serves as an Editor in two journals of Nature Research: ‘Light: Science and Applications’ and ‘Microsystems and Nanoengineering’. He also serves as Associate Editor in "Advanced Devices and Instrumentation" -a Science-Partner Journal. He has contributions in the development of several companies, which include Si-Ware Systems, Fluidion, Memscap and Izonics.