Keynote: Water harvesting, desalination and quality control with silicon metasurfaces and microfluidic devices

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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, where he took several executive positions as Dean for Research of ESIEE Paris (2012-2015 and since 2021) and Associate Vice-President for Research of Université Gustave Eiffel (2021-2022). He is affiliated to the French National Center for Scientific Research (CNRS) within the ESYCOM laboratory UMR9007. Before joining back ESIEE in 2002, Dr. Bourouina 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 French National Center for Scientific Research (CNRS) and at The University of Tokyo (1998-2001) as Senior Researcher in LIMMS Lab (CNRS UMI 2820). He also used to serve as the Director of the ESIEE-NTU Singapore Dual-Degree Master of Engineering (2003-2006). In 2017, he was the recipient of the Chinese Academy of Sciences President's Fellowship. Dr. Bourouina has many contributions in the development of several companies launched by his former students and colleagues, which include Si-Ware Systems, Fluidion, Memscap, MEMS-Schlumberger and Izonics. Among his contributions to the international scientific community, Dr. Bourouina served in the Technical Program Committee of IEEE MEMS (2012-2013). He is now serving 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 and Associate Editor in "Optical Microsystems" -an SPIE Journal. His current interest includes micro-scale photonic and fluidic devices and the related physics as well as their applications to sustainable development.

ABSTRACT

In the context of the Anthropocene and its consequences on fresh water scarcity, we explore the potential of silicon-based devices for the purpose of sustaining the availability of fresh water resources. First, we will introduce meta-surfaces based on black-silicon, specifically designed for the collection of water from air thanks to their radiative and wetting properties. Another class of meta-surfaces are meta-foams, which were developed and specifically designed for optimal water desalination. A third class of meta-surfaces relate to functionalized silicon for photocatalytic purification of water. Finally we will review solutions suitable monitoring various chemical and particulate pollutants of drinking water, including micro-plastic and biological contaminants.