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Editors

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Introduction

The SPIE Smart Nano+Micro Materials and Devices, a multidisciplinary forum focused on the use of micro- and nanofabrication technologies for addressing current global problems on energy sustainability and sensing, was held on 4–7 December at Swinburne University of Technology in Melbourne, Australia.

Synergy between basic research and engineering, i.e., between fundamentals of light-matter interaction and basic laws of thermodynamics with practical solutions and design of devices, is essential for paving the most efficient route to the development of practical solutions for our household and industry applications. A rigorous analysis of the efficiency in energy harvesting of different sorts: light-to-electrical, light-to-chemical, light-to-thermal, mechanical-to-electrical, etc., has to be undertaken based on basic laws of physics and guide practical applications.

Availability, abundance, and cost of materials for future solar energy harvesting are becoming key factors for choosing the right path for practical devices. This is dictated by the scaling laws and large surface area requirements for the energy harvesting solutions by solar cells. A multidisciplinary discussion and collaboration considering the most advanced current fabrication technologies is required due to increasingly complex and usually three-dimensional (3D) designs of promising light harvesting solutions.

Three inspiring plenary talks:

- Nanomaterials in Photovoltaics, by Martin A. Green (University of New South Wales, Australia)
- Photonics Band-Gap Materials: Light Trapping Crystals, by Sajeev John (University of Toronto, Canada)
- Nanophotonics: Thermal and Solar Applications, by Shanhui Fan (Stanford University, United States)

presented practical challenges we are facing and should overcome for realization of the most efficient light and thermal energy harvesting. It is not surprising that some of the light trapping solutions remind us of patterns found in nature. The difference from a bio-mimetic approach is, however, that those designs are driven by the fundamental understanding of science underpinnings of the most efficient light trapping.

Very strong presence of microfluidics on the fundamental science level as well as at the level of practical applications and devices was appreciated by conference participants. Wide field of opto-/acousto-mechanics, bio-reactors, cell particle sorting, etc. applications was covered by presentations. Novel

principles in sensing and control of nano- and micro-materials will be guided by the discussed methods.

Laser-based fabrication methods of complex 3D structures by direct write approach with ultra-short laser pulses had a strong presence at the conference. Demonstrations of new materials, principles of their design, processing and fabrication of micro-/nano-optical elements to control light at micro and nano-scales were highlights of the conference. Use and incorporation of plasmonic nano-particles in optical memory and waveguiding applications are very promising in sensing.

Nearly 150 papers on new research in these topics were presented in the three-day event. All morning sessions were plenary and invited talks in a single stream covering a wide spectrum of the most recent developments in related fields from basics to applications. This strategy was well accepted by conference participants. The afternoon sessions were more specialized and were carried out in four parallel streams. The conference was hosted by Swinburne University: home of strong biophotonics and nanophotonics research centered at the Centre for Micro-Photonics.

We acknowledge support of the conference by SPIE, Faculty of Engineering and Industrial Sciences, Swinburne University, colleagues and students of our Centre for the help in preparation and during the meeting. We are grateful to John Morris Scientific company for establishing the best poster awards.

We thank all the participants — the smart teams behind development of smart materials and devices.

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