

**Title** High-power-density heat-managing miniaturized redox flow batteries:  
Fusing cooling and power delivery in 3D-integrated electronics

**Speaker** Prof. Dimos Poulikakos  
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**Date & Time** Friday, March 17, 2017 4:00 p.m.

**Place** I<sup>2</sup>CNER Hall, Ito campus, Kyushu University

### Abstract

The miniaturization of redox flow cells (RFCs) paves the way to novel energy conversion concepts combining power delivery and heat regulation. Envisioning the integration of high-power-density RFCs into electronic devices such as microprocessors, lasers, or light-emitting diodes for the purpose of providing power and heat management simultaneously, optimisation of the enabling microfluidic networks in miniaturized flow cells is critical. Employing 3D-printing for the facile and inexpensive fabrication of these networks, we demonstrate RFCs with maximum power densities of up to 1.4 W cm<sup>-2</sup> at room temperature and net power densities of up to 0.99 W cm<sup>-2</sup> after subtracting pumping power losses (highest reported to date). The electrolytes employed modest concentrations of 0.4 M K<sub>4</sub>Fe(CN)<sub>6</sub> and 0.2 M 2,6-dihydroxyanthraquinone in alkaline electrolyte. I will thereby show that rational tailoring of fluidic networks in RFCs is key for the development of devices effectively and efficiently combining power delivery and thermal management.

### About the Speaker

Professor Dimos Poulikakos holds the Chair of Thermodynamics at ETH Zurich, where in 1996 he founded the Laboratory of Thermodynamics in Emerging Technologies in the Institute of Energy Technology. He was a Member of the Research Commission of ETH (2001-2005). He served as the Vice President of Research of ETH Zurich in the period 2005-2007. Professor Poulikakos was the ETH director of the IBM-ETH Binnig-Rohrer Nanotechnology center, a unique private-public partnership in nanotechnology at the interface of basic research and future oriented applications (2008-2011). He served as the Head of the Mechanical and Process Engineering Department at ETH Zurich (2011-2014).

His research is in the area of interfacial transport phenomena and thermodynamics with a broad range of emerging technologies and applications. The focus is on understanding the related physics, in particular at the micro- and nanoscales and employing this knowledge to the development of novel technologies. Specific current examples of application areas are the direct 2D and 3D printing of complex liquids and colloids down to nanoscale feature size and resolution, the science-based design of supericephobic and omniphobic surfaces, the chip/transistor-level bio-inspired 3D integrated powering and cooling of electronics, the development of facile methods for the fabrication of plasmonic sunlight absorbers and the development of surface textures for biological applications under realistic fluidic environments (accelerated and guided cell adhesion, re-endothelialization, antifibrotic surface textures and materials).

**Host:** Professor Yasuyuki Takata

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