

# IAS Distinguished Lecture

## From Water Trampolining to Ice Jumping: Physics and Nanoengineering of Materials with Intrinsic Extreme Icephobicity

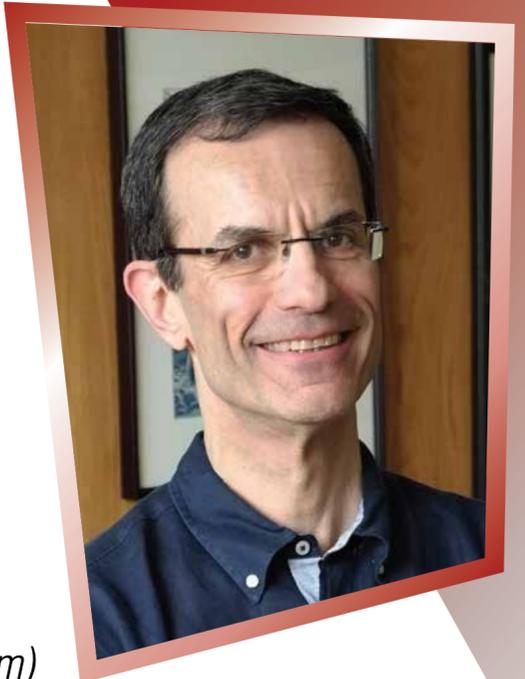
### Professor Dimos Poulikakos

Professor and Director, Lab of Thermodynamics in Emerging Technologies,  
Department of Mechanical and Process Engineering, ETH Zurich

**Date** : 28 February 2017 (Tuesday)

**Time** : 10:30am – 12:00nn (*Light refreshments will be served from 10:00am to 10:30am*)

**Venue** : Connie Fan Multi-media Conference Room, 4/F, Cheng Yick-chi Building,  
City University of Hong Kong



### Abstract

The interaction of liquids with surfaces is commonplace in nature and a broad palette of technological applications. In this lecture, I will mainly discuss the behavior of cold (below the freezing point) liquid droplets interacting with surfaces. This is an ever-present (thermodynamically metastable) liquid state leading to freezing. I will show how phenomena like recalescence, known from metal solidification, for example, manifests itself in water freezing on surfaces. Such phenomena bring with them interesting, unexpected and unexplored physics, the direct implications of which can be harvested toward the design of surface nanotextures with extreme and "intrinsic" resistance to icing. I will show in this context how cold water droplets, resting on with so-designed superhydrophobic surfaces can spontaneously remove themselves, without external interference, despite complete surface rigidity, either with self-levitation and jumping, or with self-dislodging out of the surface upon freezing. Finally, inspired by the function of butterfly wings, I will discuss elastic materials such as textiles or plastic sheets of various kinds, and show that material elasticity can be designed to significantly enhance the superhydrophobicity and icephobicity of surfaces.

### Biography

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 related materials nanoengineering, with a host of related 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 with nanoscale feature size and resolution, the science-based design of supericephobic and omniphobic surfaces, the chip/transistor-level 3D integrated cooling of electronics, the development of facile methods based on plasmonics for sunlight management and the development of biologically relevant nanofluidic technologies and surface textures for biological applications under realistic fluidic environments (accelerated and guided cell adhesion, re-endothelialization, antifibrotic surface textures and materials).

Professor Poulikakos has supervised to completion over 65 Doctoral dissertations to date. He has published over 400 research articles in top peer reviewed journals in areas such as heat transfer, fluid dynamics, energy, nanotechnology, materials, chemistry and chemical engineering, applied physics, and bioengineering/biophysics, as well as numerous articles in proceedings of professional conferences and a graduate level textbook on Conduction Heat Transfer (Prentice Hall, 1994). He has also edited and co-authored a special volume of *Advances in Heat Transfer* (1996), dedicated to transport phenomena in materials processing.

Among the awards and recognitions he has received for his contributions are the White House/NSF Presidential Young Investigator Award in 1985, the Pi Tau Sigma Gold Medal in 1986, the Society of Automotive Engineers Ralph R. Teeter Award in 1986, the University of Illinois Scholar Award in 1986 and the Reviewer of the Year Award for the ASME Journal of Heat Transfer in 1995. He is the recipient of the 2000 James Harry Potter Gold Medal of the American Society of Mechanical Engineers. He was a Russell S. Springer Professor of the Mechanical Engineering Department of the University of California at Berkeley (2003) and the Hawkins Memorial Lecturer of Purdue University in 2004. He received the Heat Transfer Memorial Award for Science in 2003 from ASME. In 2008 he was a visiting Fellow at Oxford University and a distinguished visitor at the University of Tokyo. He is the recipient of the 2009 Nusselt-Reynolds Prize of the World Assembly of Heat Transfer and Thermodynamics conferences (awarded every four years), for his scientific contributions. He is the 2012 recipient of the Max Jacob Award, for eminent scholarly achievement and distinguished leadership in the field of fluidics and heat transfer. Awarded annually to a scholar jointly by (ASME) and (AIChE), the Max Jacob Award is the highest honor in the field of thermofluidics these professional organizations bestow. He was presented with the Outstanding Engineering Alumnus Award of the University of Colorado in Boulder in 2012. He received the Dr.h.c. of the National Technical University of Athens in 2006. In 2008 he was elected to the *Swiss National Academy of Engineering (SATW)*, where from 2012 to 2015 he also served as president of its science board.

Professor Poulikakos has been a frequent keynote speaker in many conferences worldwide. He is the Editor in Chief of the Journal the Experimental Heat Transfer, and a member of the board of Editors of Scientific Reports (Nature publishing), the Journal of Microscale and Nanoscale Thermophysical Engineering, the Journal of Nanoparticle Research, the Journal of Porous Media, and the Intl. Journal of Heat and Mass Transfer. He was also an Editor of the Journal ACTA Mechanica 2000-2005. He is the European Editor of the Intl. Journal of Transport Phenomena. He has served as an associate editor of the ASME Journal of Heat Transfer 1999-2002. He is a Fellow of the American Society of Mechanical Engineering (ASME).

Online registration: [www.cityu.edu.hk/ias/events](http://www.cityu.edu.hk/ias/events)

**All are welcome**

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