Abstract: Miniaturization to impressively small dimensional scales has already been demonstrated in information storage, electronics, manufacturing, and recently, micro-electro-mechanical systems (MEMS). However, development of equivalent small-scale power sources seems to be lagging in this quest for systems miniaturization. Currently available, grid-independent power sources are predominantly chemical batteries, which are devices of notoriously limited power density. Exploiting the high power density of hydrocarbons in “liquid fuel batteries” could increase drastically the autonomy of portable power sources and provide a substantial degree of independence of human activity from centralized grids. In this talk, we will review the fundamental challenges involved with putting the high power density of combustion to work in the micro-scale and outline several approaches to address these challenges. The focus will be mainly on two subjects: First, a novel burner design will be presented, which is based on the combination of JP8 fuel electrosprays with catalytic combustion on a novel catalytic reactor that allows significant miniaturization in comparison to the classic monoliths. This will provide an idea on the design modifications necessary to achieve micro-combustion. At a second, more fundamental level, we will examine oscillatory phenomena observed in small-scale ducts that reveal a realm of flame stabilization that has not been observed in the large scale. In parallel, a brief overview will be offered of parallel research efforts in the field (such as the miniaturization of large scale power-cycles) and their limitations will be discussed.

Bio: Dimitrios C. Kyritsis is an Associate Professor in the Department of Mechanical Science and Engineering at the University of Illinois at Urbana-Champaign. He received his Diploma in Engineering from the National Technical University of Athens in Greece in 1992 and his M.A. and Ph.D. from Princeton University in 1995 and 1998, respectively. Before his current appointment, he was a post-doctoral associate and a lecturer at the Department of Mechanical Engineering at Yale University. His research focuses in the areas of combustion in the meso- and micro-scale, flame – flow interaction, and laser-based combustion diagnostics. He is the recipient of the NSF CAREER award, the Accenture Award for excellence in advising, the Everitt and Rose awards for excellence in teaching and a Fellow of the Center for Advanced Study of the University of Illinois at Urbana-Champaign (2007-8).

Light refreshments will be available beginning at 3:45pm in 3-270. For more information on Micro Nano seminars, or to be added to our mailing list, please contact Thea Szatkowski at theaszat@mit.edu.