

TITLE: Thermal Management Research from 3D Chips to Power Electronics

Ken Goodson

Davies Family Provostial Professor

Professor of Mechanical Engineering and, by courtesy, of Materials Science and Engineering

Senior Associate Dean for Faculty & Academic Affairs in the School of Engineering

Stanford University

<https://profiles.stanford.edu/kenneth-goodson>

<https://nanoheat.stanford.edu/>

## ABSTRACT

Thermal management is critical for electronic systems ranging from servers and smartphones to vehicle converters. Advanced materials and microfluidics are the hallmarks of many exciting solutions on-chip and in packaging. Thermal *metamaterials* are particularly promising because they offer unusual combinations of thermal, mechanical, fluidic, and other properties by means of micro- or nanoscale heterogeneity, porosity, and/or layering. This seminar will overview a number of promising technologies for 3D circuits, including “thermal ground plane” technologies that aggressively spread heat using liquid-vapor phase change or phonon transport at the limits of the associated physics. We are upscaling the performance and efficiency of capillary and pumped microfluidic systems using novel (and scalable) manufacturing methods. This talk summarizes progress and highlights our decades of collaboration with the semiconductor industry and specialists in nanofabrication and electrical engineering.

## BIO SKETCH

Ken Goodson is the Davies Family Provostial Professor at Stanford, where he holds appointments in Mechanical Engineering and (by courtesy) Materials Science. He has graduated 45 PhDs, who are distributed evenly between IC companies and academic careers at MIT, UC Berkeley, and other schools. Goodson’s is a member of the National Academy of Engineering and a Fellow with ASME, IEEE, APS, AAAS, and the National Academy of Inventors (NAI). Other awards include the ASME Kraus Medal, the inaugural IEEE Richard Chu Award, the AIChE Kern Award, and the SRC Technical Excellence Award. Goodson has 35 patents and co-founded Cooligy, which built heat sinks for the Apply G5 and was acquired by Emerson in 2006. Goodson served as Stanford Mechanical Engineering Chair and Vice Chair (2008-2019), leading two strategic plans and recruiting 15 faculty who transformed the department’s scholarship and diversity. He is now the Senior Associate Dean for Faculty & Academic Affairs in the School of Engineering.

