

Micro and Nano Technologies for Enhanced Thermal Management of Electronic Components

Thermal management technology plays a key role in the continuing miniaturization, performance improvements, higher reliability and reduced SWaP-C of electronic systems. For the past decade, and particularly the past 5 years, DARPA has aggressively pursued the application of micro- and nano-technology to reduce thermal constraints on the performance of defense electronic systems. These efforts have centered on development of compliant but highly conductive thermal interface materials, with thermal resistivities $< 0.01 \text{ cm}^2 \text{K/W}$; thermal spreaders relying on biporous wicks and phase change processes to provide effective thermal conductivities 10 times higher than diamond, with values in the range of 10 kW/mK - 20 kW/mK ; and intrachip thermal management techniques exploiting diamond and microfluidics to reduce the near-junction thermal resistance by a factor of 3.

This presentation will review the status of the DARPA thermal management program with emphasis on the underlying physical phenomena and thermal characteristics of specific technologies. Unique metrology required to accurately quantify the targeted reductions in thermal resistance will also be described. The presentation will close with future challenges and opportunities in the thermal management of defense electronics.

Avi Bar-Cohen

Program Manager, DARPA/MTO



Dr. Avram Bar-Cohen is a Program Manager in the Microsystems Technology Office of DARPA. He is serving in this capacity while on leave from his position as a Distinguished University Professor at the University of Maryland, where he most recently also served as the Chair of the Mechanical Engineering Department (2001-2010). Bar-Cohen earned a PhD in mechanical Engineering from the Massachusetts Institute of Technology. His interests include the thermal management of electronic components and systems and techniques for energy-efficient sustainable design of manufactured products. He is an Honorary Member of ASME and a Fellow of IEEE.