MICRO HEAT ENGINES FOR WASTE HEAT HARVESTING

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Microelectromechanical system (MEMS) technologies enable the fabrication of heat engines at the microscale for distributed power generation and waste heat recovery. Power-plants-on-a-chip, such as micro steam turbines and other novel concepts to convert heat into electricity at small scale have therefore been developed over the past decade, raising non-traditional challenges in fluid mechanics and heat transfer. These can be used to power wireless sensors from distributed heat sources or improve the efficiency of energy systems by harvesting waste heat. This presentation will first describe micro heat engines, including micro-turbomachinery-based steam engines and piston engines that implement traditional thermodynamic cycles (Rankine, Stirling) as well as novel heat engine approaches enabled by microscale phenomena. The thermofluidic challenges that arise when miniaturizing these machines will be highlighted, including low Reynolds number microturbomachinery flows, high frequency oscillating gas flows, conjugate heat transfer, and dynamic phase change behavior in microchannels.