Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

III/V Nanowire-based Devices for Thermoelectrics VALENTINA TRONCALE, PHILIPP MENSCH, SIEGFRIED KARG, HEINZ SCHMID, PRATYUSH DAS KANUNGO, EMANUEL LOERTSCHER, UTE DRECHSLER, VOLKER SCHMIDT, HEIKE RIEL, BERND GOTSMANN, IBM Research GmbH, Saumerstrasse 4, CH-8830, Rueschlikon, Switzerland, NANOSCALE ELECTRONICS TEAM[1] — The thermo-physical properties of one-dimensional semiconductor nanostructures make them suitable for high ZT thermoelectric devices. Theoretical studies indicate that III/V nanowires (NWs) are eligible for ZT enhancement, due to increased phonon scattering resulting in thermal conductivity (k) suppression, without affecting the electrical conductivity (s). We address the thermoelectric properties of III/As NWs grown by selective-area MOVPE on Si (111) substrates, transferred onto micro-fabricated MEMS-based devices, optimized for direct thermal transfer measurements. The NWs were positioned across the gap between adjacent symmetric SiNx membranes, structured on Si. Platinum resistive heaters/thermometers connected to leads, and contacts to the NWs were realized by electron beam lithography and lift-off technique. The structures were then under-etched. For InAs NWs, we compared the k measured by both the direct method and the self-heating technique. Heat loss to the substrate and contact resistance were evaluated by finite elements simulations and compared for different fabrication techniques. We discuss alternative solutions to the technical challenge of precise NW positioning.

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Date submitted: 29 Nov 2012 Electronic form version 1.4