Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Monolithically integrated microfluidic channels in silicon for chip cooling AHMET TURNALI, ONUR TOKEL, Bilkent University, TAHIR COLAKOGLU, MONA ZOLFAGHARI, Middle East Technical University, IHOR PAVLOV, Bilkent University, ALPAN BEK, RASIT TURAN, Middle East Technical University, FATIH OMER ILDAY, Bilkent University — The challenge in scaling chips and increasing clock rates is mainly due to limitations in removing excess heat. In order to overcome the stubborn heat removal problem, air and liquid based cooling with fans and metallic plates is used. However, these methods have low heat-removal efficiency and undesired thermal resistance. To solve these problems, microfluidic cooling approaches are emerging, which exploit microchannels positioned on wafer surfaces. Here, we report a laser-based method, which enables carving fully embedded microfluidic channels deep inside Si without damaging wafer surfaces. The method relies on our recent results[1], which enables creation of structural modifications inside Si. Modified subsurface volumes are then chemically etched away with a custom etchant to create the microchannels inside the chip. The microchannels carrying liquid coolant are then experimentally shown to cool Si chips, which is the first demonstration of monolithically-cooled chips with in-chip microchannels. This constitutes a disruptive method that can facilitate multi-level integration of chips, and increased clock rates, and may also lead to in-chip bio-applications. [1] Turnali et.al. Laser-driven self-organised functional 3D superstructures deep inside silicon, Nature (under review)

Ahmet Turnali
Bilkent University

Date submitted: 11 Nov 2016 Electronic form version 1.4