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Titanium based flat heat pipes for computer chip cooling GAURAV SONI, CHANGSONG DING, MARIN SIGURDSON, PAYAM BOZORGI, BRIAN PIOREK, NOEL MACDONALD, CARL MEINHART, University of California Santa Barbara — We are developing a highly conductive flat heat pipe (called Thermal Ground Plane or TGP) for cooling computer chips. Conventional heat pipes have circular cross sections and thus can't make good contact with chip surface. The flatness of our TGP will enable conformal contact with the chip surface and thus enhance cooling efficiency. Another limiting factor in conventional heat pipes is the capillary flow of the working fluid through a wick structure. In order to overcome this limitation we have created a highly porous wick structure on a flat titanium substrate by using micro fabrication technology. We first etch titanium to create very tall micro pillars with a diameter of 5 μm, a height of 40 μm and a pitch of 10 μm. We then grow a very fine nano structured titania (NST) hairs on all surfaces of the pillars by oxidation in H_20_2. In this way we achieve a wick structure which utilizes multiple length scales to yield high performance wicking of water. It's capable of wicking water at an average velocity of 1 cm/s over a distance of several cm. A titanium cavity is laser-welded onto the wicking substrate and a small quantity of water is hermetically sealed inside the cavity to achieve a TGP. The thermal conductivity of our preliminary TGP was measured to be 350 W/m-K, but has the potential to be several orders of magnitude higher.

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