Scanning Thermal Microscopy of Novel Devices and Microstructures

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The scanning thermal microscope (SThM) uses a temperature-sensitive cantilever probe in an atomic force microscope (AFM) to simultaneously obtain topographical and thermal images of a material surface. The SThM has been used to map the temperature of individual Si and GaAs transistors as well as vertical-cavity surface emitting lasers. This paper will report the effects of device geometry, device operation condition as well as thermal and electrical properties, on the temperature rise and Joule heating in these devices. The mechanism of probe-sample heat transfer as well as the limits on spatial resolution will be discussed. A new spin-off from SThM, which can probe Joule heating below 50 nm spatial resolution, will also be illustrated.