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Microwave impedance imaging on semiconductor memory devices
WORASOM KUNDHIKANJANA, KEJI LAI, YONGLIANG YANG, MICHAEL KELLY, ZHI-XUN SHEN, Geballe Laboratory for Advanced Materials, Departments of Physics and Applied Physics, Stanford University, CA 94305 — Microwave impedance microscopy (MIM) maps out the real and imaginary components of the tip-sample impedance, from which the local conductivity and dielectric constant distribution can be derived. The stray field contribution is minimized in our shielded cantilever design, enabling quantitative analysis of nano-materials and device structures. We demonstrate here that the MIM can spatially resolve the conductivity variation in a dynamic random access memory (DRAM) sample. With DC or low-frequency AC bias applied to the tip, contrast between n-doped and p-doped regions in the dC/dV images is observed, and p-n junctions are highlighted in the dR/dV images. The results can be directly compared with data taken by scanning capacitance microscope (SCM), which uses unshielded cantilevers and resonant electronics, and the MIM reveals more information of the local dopant concentration than SCM.

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