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Local strain analysis for CMOS technology by Raman and Nano-Raman spectroscopy

MICHAEL HECKER, AMD Saxony LLC & Co. KG

In present and future high performance CMOS devices, the dedicated introduction of mechanical strain into active silicon regions is an important challenge to progress technology. For both basic understanding of the structure-strain relationship and for developing improved device structures, local measurement of the strain state has become essential. A promising technique that meets these requirements is Raman spectroscopy, enabling strain and composition determination in silicon structures on the μm-scale with high accuracy. Locally enhanced Raman intensities due to tip enhanced Raman spectroscopy (TERS) can be utilized to downscale the spatial resolution of Raman spectroscopy significantly below the optical diffraction limit. It will be shown for various strained silicon and silicon-germanium film structures, that optical near-field information can be obtained on a scale promising for CMOS device characterization. Local strain measurements are achieved utilizing TERS with metal coated AFM tips positioned in the region of interest. Experimental results of μRaman and of TERS scans for the strain distribution in island and line structures of thin films are discussed as well as possibilities and limitations for further improvement of the spatial Raman resolution.