Delta-doped imagers for UV and EUV applications

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The large imaging format, high sensitivity, compact size, and ease of operation of silicon-based sensors have led instrument designers to choose them for most visible-light imagers and spectrometers for space-based applications, and this will probably remain the case in the near future. In fact, technologies presently under development will tend to strengthen the position of silicon-based sensors. CCD-CMOS hybrids currently being developed may combine the advantages of both imagers and new high-gain amplifiers and could permit photon-counting sensitivity even in large-format imagers. Back-illumination potentially enables silicon detectors to be used for photometry and imaging applications for which front-illuminated devices are poorly suited. Generally, back illumination requires treatment of the back surface such as delta doping.

Delta-doped CCDs were developed at the Microdevices Laboratory at the Jet Propulsion Laboratory in 1992. Using molecular beam epitaxy, fully-processed thinned CCDs are modified for UV enhancement by growing 2.5 nm of Boron-doped silicon on the back surface. Named delta-doped CCDs because of the sharply-spiked dopant profile in the thin epitaxial layer, these devices exhibit stable and uniform 100% internal quantum efficiency without hysteresis in the visible and ultraviolet regions of the spectrum. In this paper we will discuss, performance of delta-doped CCDs in UV and EUV, our in-house thinning capability, bonding approaches for producing flat focal plane arrays, and in-house capabilities of directly applied antireflection coatings. Recent activities on the extension of delta doping technology to other imaging technologies will also be presented.

The work presented in this paper was performed by the Center for Space Microelectronics Technology, Jet Propulsion Laboratory, California Institute of Technology, and was jointly sponsored by the National Aeronautics and Space Administration, Office of Space Science and the JPL's Director Research and Development Fund.