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Deep Level Transient Spectroscopy and Shockley-Hall-Reed Recombination

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Some defects, and certain impurities, can create electronic states within the band gap of a semiconductor. These can have dramatic effects on the electrical properties by acting as recombination or generation centres. Examples of concern to device applications are recombination centres reducing the efficiency of solar cells or LEDs and generation centres reducing performance of DRAM or increasing the reverse leakage of power devices. In many cases it is possible to estimate the effect that such defects will have on device performance by considering Shockley-Hall-Reed (SHR) kinetics. In order to do this some of the defect parameters must be known. In this presentation I will review how Deep Level Transient Spectroscopy (DLTS) can provide appropriate measurements of the defect energy depth, concentration and carrier capture cross sections for the SHR calculation. The use of DLTS for the measurement of both majority and minority carrier properties will be considered. For some applications it is necessary to distinguish between states with very similar carrier emission properties. In these cases high resolution DLTS provides significant advantages and a brief outline of the development of Laplace DLTS will be given illustrated by its application to gold in silicon and SiGe.