

# Contactless determination of surface state density spectrum at GaAs(100) surfaces from rigorous analysis of photon-induced effects

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Excitation-intensity-dependencies of photoluminescence quantum efficiency ( $Y_{PL}$ ) and surface photovoltage (SPV) were measured at room temperature and analyzed in order to determine the energetic distribution of surface state density,  $N_S S(E)$ , at GaAs(100) surfaces in contactless and non-destructive manner. Both techniques are based on bipolar generation by strongly absorbed light and on the rigorous analysis of drift, diffusion and recombination processes (both in volume and at surface) in order to calculate  $Y_{PL}$  and changes in surface band bending (SPV). The theoretical dependencies are computed by a simulator which solves self-consistently Poisson's equation, continuity and drift-diffusion equations for electrons and for holes in an illuminated semiconductor. We equipped the simulator with two original computer procedures for multi-parameter fitting of theoretical curves to experimental data. The former uses genetic algorithms [1], the latter the gradient-based approach. In this paper these methods were successfully applied for quantitative assessment of electronic properties of bare and sulfidated GaAs(100) surfaces in terms of  $N_S S(E)$ , surface recombination, surface band bending, and quasi-Fermi levels.

[1] Miczek et. al., Surf. Sci. 507-510 (2002) 240.

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