Abstracts

Capacitance-Voltage Characteristics of Microwave Schottky Diodes

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The capacitance of small-area microwave Schottky diodes is strongly affected by the edge effect, which is not adequately described by existing analytical models. Based on an analytical solution of Poisson's equation, we calculated capacitances of metal circular dots and metal stripes on the surface of a doped semiconductor material. When the dimensions of the dot or stripe are much larger than the depletion region, the results are reduced to the conventional formula for a parallel plate capacitor. In the opposite limit, the overall capacitance is determined by the edge effect. This edge capacitance is proportional to the device periphery, with the coefficient of proportionality dependent on the shape of the metal. In the most interesting case of a round metal dot, the edge capacitance is given by C = 4 epsilon a, where epsilon is the dielectric permittivity of the semiconductor and a is the radius of the metal dot. The parallel-plate component of the device capacitance is modulated by the applied voltage; the edge component is nearly independent of the applied voltage. Hence, the largest capacitance modulation is achieved in devices with the smallest ratio of the device periphery over the device area, which has the smallest edge effect. The measured capacitances of small round GaAs Schottky barrier diodes are in reasonable agreement with the results of our calculation.

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