HARMONIC BALANCE OPTIMIZATION OF TERAHERTZ SCHOTTKY DIODE MULTIPLIERS USING AN ADVANCED DEVICE MODEL

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Substantial progress has b2een made recently in the advancement of solid state terahertz sources using chains of Schottky diode frequency multipliers [1-3]. The multiplier diodes are often simulated using a simple Schottky junction model plus a series resistance, R_S, because of the model's simplicity and ease of use in commercial harmonic balance simulators. The DC series resistance value is useable for R_S at low frequencies, but at high frequencies the value must be increased to match the measured RF performance. The junction properties are determined from forward I-V measurement.

Nevertheless, many other factors are well-known to participate in the diode behavior [4]. These include time-dependent velocity saturation [5], carrier inertia and shunt capacitance in the undepleted active layer, tunneling through the Schottky barrier and heating of the junction at high powers. A diode model including all of these effects has been derived. Since it includes specialized differential equations, a harmonic balance simulator based on the reflection algorithm has been built around it. The model itself must be calibrated using ensemble Monte Carlo calculations of material parameters, but otherwise no parameters are fitted other than to DC I-V measurements[5].

The program can be used to optimize the doping concentration and diode dimensions for any multiplier, based on its frequency, input power and operation temperature. Optimizations will be demonstrated for 200, 400 and 800 GHz doublers, and comparison between calculation and measurement will be shown. The match between them will be seen to be quite close.

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