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Reversely Switched Dynistor: From Si to SiC

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The reversely switched dynistor(RSD) is proposed by Prof. I. V. Grekhov in 1980s, which is a kind of semiconductor switches applied in pulsed power area especially. Based on the controllable plasma layer commutation principle, Si RSD is famous for its good serial characteristics, low loss and high di/dt capability. It is hopeful to get higher monolithic blocking voltage and better performance for repetitive frequency by using the silicon carbide(SiC) material to fabricate the RSD because of its 10 times higher insulated breakdown electric field, 3 times higher bandgap width and 3 times higher thermal conductivity, etc.

By establishing the two-dimensional numerical models of the Si RSD and SiC RSD respectively, their characteristics are researched into comparatively. The results show that: (1) SiC RSD could get the same blocking voltage as Si RSD with about 1/10 width of the drift region. (2) It is important for both Si RSD and SiC RSD to accumulate enough electric charges in the triggering process, so as to turn on normally and reduce the residual voltage at the front edge of the pulse. With the same conditions of the blocking voltage, chip area and main circuit, SiC RSD needs higher level of the pre-charge because of shorter carrier lifetime. (3) For the quasi-static voltage drop in the turn-on process, only when the voltage rate is high enough($>6\text{kV}$) can SiC RSD have advantage over Si RSD. It is because the wide bandgap of SiC leads to high junction voltage drop, and the advantage of the bulk voltage drop reflects at high voltage rate.

In general, it is an effective way to promote the device performance to use the new material SiC to fabricate RSD when Si RSD has almost reached its limitation. The SiC RSD chip with blocking capability has been acquired by the tape-out process.

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