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PRIMARY HIGH VOLTAGE THYRISTOR-BASED SWITCHES TRIGGERING IN IMPACT IONIZATION WAVE MODE FOR GW RANGE SOS-GENERATORS

A capability of the impact-ionization triggering of commercial thyristors was shown in our previous work. Thyristors of tablet design were triggered by an external overvoltage pulse applied across the thyristor main electrodes. The triggering pulse voltage rise rate at least 1 kV/ns was required. Under such conditions, the thyristor turns into a conductive state within 200 to 400 ps due to initiation and propagation of a fast ionization front across the semiconductor structure. This paper describes the investigation of the thyristor-based switches with impact-ionization triggering in pulse repetition mode. Commercially available thyristors with the diameter of the silicon wafer of 40 mm and an operating voltage of 2.4 kV DC were used. The thyristor-based switches contained 2 to 5 series connected thyristors and operated in this triggering mode in different discharge circuits. Switch blocking voltage was 4 to 10 kV and stored energy was 10 to 16 J. The following discharge parameters were obtained: discharge current amplitude up to 8 kA, maximum current rise rate up to 40 kA/μs, the pulse duration (FWHM) of ˜1 μs, and switching efficiency of about 0.9. We have investigated that the intrinsic recovery time was equal to ˜1 ms for the thyristors under study. Therefore, the maximum pulse repetition frequency (PRF) was up to ˜1 kHz in burst mode. More than 10ˆ6 shots were performed. After that, no thyristor degradation was observed. The novel circuit design of SOS generator with output power up to ˜1 GW was developed using thyristor-based switches as a primary switch. This design significantly increases the efficiency of the generator and decreases its cost because of the reduced number of magnetic switches. The paper will discuss the experimental circuitry, tested switches design, and results obtained.

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