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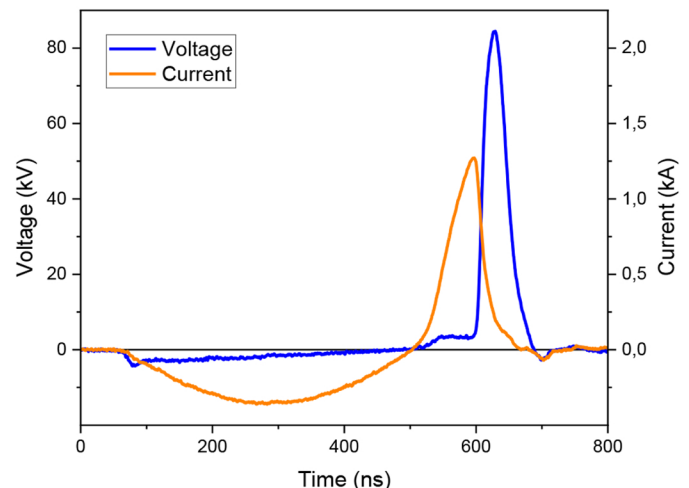
## Investigation of semiconductor opening switches for pulsed power applications with output voltage up to 500 kV

### Abstract:

The Semiconductor Opening Switch (SOS) generator is an inductive energy storage generator based on SOS diodes producing high-voltage and high-current nanosecond pulses<sup>1</sup>. The high average power, the high pulse repetition frequency (PRF) and the long lifetime of SOS generators make it possible to implement these generators in industrial pulsed power applications using radiation, plasma, particle beam and laser technologies. Although many pulsed power applications, including electron beam sterilisation, benefit from SOS technology, these switches are not widely produced by industry. Only a few manufacturers in the world produce these diodes. This fact hinders the development of pulsed power applications based on SOS. The objective of this study is to test standard diodes as a solid-state opening switch capable of handling voltages of several hundreds of kilovolts, for use in pulsed electron beam sterilisation applications.

### Results and Discussion:

Several studies are performed at different energy scales to test many off-the-shelf high-voltage diodes as an opening switch. The test involves soft and hard recovery rectifiers, avalanche, TVS diodes, etc. An experimental arrangement is developed to test the diodes. As a first step, the test bench is optimized to reduce the losses and increase the output power. Then, the diodes behaviour and output parameters are compared to an SOS reference diode. It shows that most of the diodes tested can operate as opening switches. In addition, it is observed that the operation of the diodes mainly depends on their area as well as their specific characteristics such as blocking voltage, reverse current, recovery time, etc. The off-the-shelf diodes tested to date can switch up to 100 kV voltage with 20 ns rise time and output power of about 100 MW.



Typical voltage and current waveforms of SOS diodes

### References:

1. S. N. Rukin, "Pulsed power technology based on semiconductor opening switches: A review", *Review of Scientific Instruments* 91, 011501 (2020), <https://doi.org/10.1063/1.5128297>.