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Fast and efficient techniques for High Current Interruption using Electrical Exploding Fuses

Pulsed Power Technologies involved some electrical loads which required a fast rising (ns) input high current pulses. Pulse conditioning of slow rising (μs) high current pulse is very essential in this regard. A compact and an efficient solution based on metal fuses is modeled and experimentally verified the modal validity. Metal fuses referred as Electrically Exploding Fuses (EEF) consist of wires array and are used in pulsed power fields for pulse conditioning, current interruption, and opening and closing switches. Fuses operates as a consequence of overheating by the current, which they carry, resulting in their vaporization that causes their resistance to increase drastically and effectively cut off the current. Experimental results verified that the exploding time of the fuse depends on the type of the fuse material, length of the fuse wires, and total cross-sectional area of the fuse. Further it is investigated through experiments that the rise and fall time of the fuse resistivity depends on different quenching material used in the surrounding of the fuse material. By controlling the resistivity time, very fast high voltage pulse is generated, which when used with a dielectric switch caused very fast interruption of the high current (100s of KA) pulse in 100s of nanosecond time from originally microsecond high current pulses. A simulation code is developed for prediction of fuses operation based on thermodynamic and electrical properties of the EEF and much closer experimental and simulated results are achieved. Experimentally a slow current pulse (μs) is interrupted and transferred to the load in the alternated path by using dielectric switch with fast rising time (ns).

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