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An Analysis of Strike and Restrike Characteristics of the Exploding Film Phenomenon Under Different Temperature and Pressure Conditions

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Exploding films have potential applications as fast-opening switches, current interrupters, and ignitors of explosive materials. The exploding film phenomenon is a process in which a high-voltage capacitive discharge is passed through a thin layer of metallized particles on the surface of a dielectric film. Heat generated from the increase in current forces the metallized particles from a solid to a liquid state during an initial current strike. If the metal particles experience an additional rise in current during this liquid state, a restrike may be initiated causing the particles to be liberated from the substrate itself in what is known as a flashover event. It is theorized that an increase in temperature would allow the metallized particles to reach their liquefied state at a quicker rate, resulting in an overall shorter event duration. It is also theorized that the force from the ambient pressure, in addition to the force contributed by the film's current-induced magnetic field, would need to be overcome to achieve this particle liberation. This work experimentally investigates these hypotheses by varying pressure and temperature conditions while subjecting an aluminum metallized polypropylene film to a 2 kV capacitive discharge. The comparison of electrical characteristics of the current waveform captured during the flashover event versus the plasma's physical transformation characteristics is presented.

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