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Exploratory study of shock wave production mechanisms during the process of underwater electrical wire explosion

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The pressure waveforms of shock waves generated by exploding copper and tungsten wires have been recorded and analyzed. A test platform including a microsecond time scale pulsed current source, loads, a chamber, and a diagnostic system has been established. Current and voltage waveforms were recorded by a Pearson coil and a North Star probe, respectively. Shock waves were obtained by a PVDF needle probe located 145 mm away from the source. If the stored energy of the system was enough, for a fine and long wire, there would be a quite long current pause, also known as "dwell time". In this case, the pressure probe could detect two separate shock waves. The first shock wave mainly came from vaporization of the metal wire whereas the other should come from expansion of discharge plasma channel. For a thick wire with the same length, its current pause would become shorter. The period between two shock waves would also be shorter. When the pause disappeared, the processes of vaporization and breakdown were close and only one shock wave could be found in the field area. However, with the help of a specially designed bypass switch, shock waves caused by vaporization could be separated and compared. The results illustrated that for wires with same sizes, tungsten wires could generate more powerful vaporization shock waves whereas copper wires could produce stronger expansion shock waves.

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