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Shock wave from melting and its being overtaken by shock wave from vaporization in underwater electrical wire explosion

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The shock waves generated by the underwater electrical wire explosion continuously attract attentions due to its more and more applications. In this paper, the generation mechanism of shock waves generated by the underwater electrical wire explosion was investigated. A microsecond time-scale pulsed current source is used to drive the electrical explosion of copper wires with a length of 5cm and diameters of 200μm. The energy-storage capacitor was charged to a relatively lower energy so that the energy deposited into the wire is not large enough to fully vaporize the whole wire. The discharge is in the mode of the cut-off current without the plasma formation. The discharge current and the wire voltage were measured with a Rogowski coil of Pearson 101 and a voltage divider of Tektronix P6015A, respectively. A pressure probe of PCB138 from Piezotronics was placed at a position of 100mm away from the wire and used to record the waveform of the shock wave. Two shock waves were recorded: the first and weak shock wave was confirmed to be the contribution from the wire melting, while the second and strong shock wave is the contribution from the wire vaporization. By adjusting the initial stored energy appropriately, ranging from 70J to 160J, the time interval of shock waves generated by melting and generated by vaporization can be changed conveniently. Therefore, the process of the shock wave by the vaporization overtaking the shock wave by the melting can be observed.

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