EFFECT OF CURRENT RISE RATE ON UNDERWATER ELECTRICAL EXPLOSION OF A COPPER WIRE

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The physical processes that occur during the initial stages of nanosecond explosion of thin wires play an important role in the development of plasma for nanoparticle preparation experiments. The transition of a wire material from the condensed state to conducting plasma is not yet understood completely. In this paper, electrical explosions of a copper wire were investigated underwater using pulsed voltage in the time scale of a few microseconds. A self-integrating Rogowski coil and a voltage divider were used for the measurements of the current and voltage at the wire load, respectively. The current rising rate was adjusted by changing the circuit parameter, including the discharge voltage and circuit inductance, and the characteristics of copper wires including length and diameter of copper wires, respectively. The effect of current rising rate on two phase transitions involving melting from solid to liquid and phase explosion from superheated liquid to the vapor-drop mixture were obtained by analysis of the current and voltage waveforms of copper wire explosion. The energy of melting and phase explosion were calculated and compared by experimental waveform of current and voltage. At the same time, the effect of applied voltage, circuit inductance, length and diameter of copper wire were obtained on the voltage and current waveform of electrical explosion of copper wires.