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# Investigation of Underwater Shock Wave Intensity in Different Electrical Breakdown Discharge Modes

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Powerful dynamic shock waves induced by pulsed discharge in water has been widely adopted in many industry applications, such as material processing, rock fragmentation, electrohydraulic cleaning, high intensity ultrasound source, et al. It is necessary to research on how to induce shock waves steadily and efficiently. An experiment stand of pulsed discharge is designed and constructed, based on the pin-to-plate electrode construction with the gap distance of 10 mm. Combining the measured waveform and optical images captured by a high-speed camera, it can be concluded that the discharge modes are classified as subsonic bush-like streamers or supersonic filamentary streamers. The mechanism of the subsonic streamer under lower applied voltage propagates as bubble clusters. The microbubbles are firstly generated and then discharge occurs in the bubble cluster. The volume of bubble clusters grows towards the cathode until the breakdown of the underwater gap. Experimental results demonstrate that the amplitude of applied voltage have a great influence on the discharge modes. Under higher voltage, the supersonic streamer propagates at the speed from 5 km/s to 50 km/s accompanied by higher intensity shock wave. Based on the experimental results, the morphology and shape characteristics including streamer length and number of branches under different discharge modes are discussed and the effect of the electrical breakdown discharge modes on the shock wave intensity in water is evaluated. The time delay of the pre-breakdown process, the propagation velocity of the streamer, the energy loss in the pre-breakdown process, the energy conversion efficiency, etc., are analyzed and compared under different discharge modes. In the experimental conditions a threshold value of 22.5kV is necessary for the subsonic streamers turning into supersonic streamers, which is a remarkable measure to reduce the energy loss and improve the energy conversion efficiency and eventually enhances the shock wave intensity.

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