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4P57 - ABLATION BEHAVIORS AND IMPLOSION DYNAMICS OF PRECONDITIONED TWO-WIRE Z-PINCH

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Experiments of two-wire Z-pinchs are carried out, in which an adjustable current prepulse is introduced to preheat the wires before the main current start. Experimental results show that the time delay (T_{delay}) between the prepulse and the main pulse has a fatal effect on the ablation behavior and the dynamic of implosion.

The two-wire load is heated to a core-corona state by the prepulse current, and a two-layer structure of mass distribution is formed. The mass expands freely during the interval T_{delay} . Thus the mass distribution of the load at the instant when the main current start can be controlled by changing T_{delay} , which was adjusted from ~ 200 ns to ~ 1 μ s. It is observed that under a short T_{delay} (~ 200 ns), the preconditioned load shows an ablation stage as the typical wire array Z-pinch. And the ablation stage was nearly suppressed as the T_{delay} increases to 1 μ s. The changing of the ablation behaviors of the preconditioned load can be related to the interaction of the imploding plasma shell and the expanding dense core.

The imploding trajectories of the preconditioned load under different T_{delay} are obtained from optical diagnostics. The stagnation instant would be postponed with a longer T_{delay} , showing the potential of increasing energy conversion efficiency in wire array Z-pinch using an adjustable prepulse. In addition, a circuit model coupled with 0D load model is developed to describe the imploding of the preconditioned load, and the calculation result has a good agreement with the experimental trajectories.

This research shows the effect of the prepulse parameter on the dynamics of two-wire Z-pinchs, the results of which are valuable as the reference to the future multi-wire experiments. And the prepulse approach is hopeful in the suppression of instability of wire array Z-pinch according to the research.

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