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GENERATION OF AR K-SHELL RADIATION USING A HYBRID GAS PUFF WITH AN OUTER PLASMA SHELL. *

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In our work, we investigated a new type of load, a hybrid gas puff with an outer plasma shell, as a plasma radiation source for efficient production of K-shell radiation at microsecond implosion times. We used the hybrid load of the following type. The inner argon shell was actually a solid gas jet on the axis of the system with a diameter of 20 mm. An outer deuterium shell played a role of an implosion stabilizer and a current sharpener for the inner gas jet. The outer shell was formed at a diameter of 80 mm, extending outward to large initial radii. The falling profile of the gas density should ensure stable implosion of the gas puff for hundreds of nanoseconds while the generator current rose. The third component of the hybrid load was the outer plasma shell located at the diameter of 350 mm, which provided the initial conductivity and reduced the negative effects of the "cold start". The experiments have been carried out on the GIT-12 generator. The generator was operated in a microsecond mode that provides 4.7-MA current with the current rise time of 1.7 μs in a short-circuit load at a charging voltage of 50 kV.

The experiments showed that the hybrid gas puff with the outer plasma shell is capable to provide a stable Z-pinch compression at implosion times of 750-800 ns. The plasma column radiating in Ar K-shell lines had a typical diameter of 1-1.5 mm, and FWHM of the radiation pulse was in the range from 2.5 to 6 ns. The data on the Ar K-shell radiation power and yield were obtained for the Ar-D_2 gas puffs with different initial parameters. The experimental data were compared to the theoretical predictions of an expected K-shell yield at a certain current level in order to estimate the efficiency of a new type of K-shell plasma radiation source. The maximum Ar K-shell radiation power and yield observed in the experiments were 570 GW/cm and 1.6 kJ/cm at the peak implosion current of 2.9 MA and the implosion time of 780 ns. However, the efficiency of the plasma radiation source reached only 70%, i.e. the experimental K-shell radiation yield was still 30% lower in comparison with the theoretical predictions. Nevertheless, we consider this type of Z-pinch load as promising and plan to continue our research in this direction.

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