DOMINATION OF THE K-RADIATION AT A Z-PINCH STAGNATION ON Z BY NUMEROUS TINY SPOTS AND THE PROPERTIES OF THE SPOTS INFERRED BY EXPERIMENTAL DETERMINATION OF THE K-LINE OPACITIES

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Detailed analysis of both the line-intensity ratios and line shapes of the K-lines of elements of different abundances (Fe, Cr, Ni, and Mn) emitted from the stagnation of a steel wire-array implosion on Z, were used to determine the line opacities. While the opacities at the early time of stagnation appear to be consistent with a nearly uniform hot-plasma cylinder on-axis surrounded by a colder annulus, the opacities during the peak K-emission strongly suggest that the main K-emission is due to small hot regions (spots) spread over the stagnating column. The spots are shown to be at least 4× denser than expected based on a uniform-cylinder emission (namely, $n_i > 3\times10^{20}$ cm^{-3}), are of diameters of about 200 μ or less (where the smaller the spots the higher are the densities) , and are thousands in number. The total mass of the spots was determined to be 3–10 % of the load mass, and their total volume 3–15 % of the Ø 1.2-mm stagnation-column volume, both are less than the respective values for the earlier period of lower K power.

T_e of the spots was determined from line-ratios, accounting for the true line opacities. Radiation power and energy considerations yield that the lifetime of the spots is 0.5–1 ns (the lifetime can be shorter due to expansion or thermal conduction), suggesting that the spots are continuously replaced by others, or being continuously heated during the 2-ns-long peak-power period. The rest of the mass in the on-axis region during this period is estimated to be about 50% of the load with T_e about 1000 eV, explaining most of the observed soft radiation.

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