HIGH-DENSITY IMPLOSION VIA SUPPRESSION OF RAYLEIGH–TAYLOR INSTABILITY

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Rayleigh–Taylor instability (RTI) is thought as a major cause that spoils energy gain in inertial confinement fusion. It is known that the RTI is suppressed by a high-Z doped target owing to high ablation velocity [2], while the resultant areal density of the implosion experiment is not enhanced by the reduction of the RTI. In a shell implosion, preheating due to the emission from the high-Z dopant is as important as the RTI, so a cautious consideration is required to achieve a high-density implosion using the high-Z doped shell.

One-dimensional (1D) radiation hydrodynamics (RHD) simulations were conducted with high-Z opacity based on the detailed configuration accounting model. The result suggests that a 0.05%-brominated plastic shell loses the peak areal density because of the shell preheating (Fig. 1), and a thick shell target is suitable for the high-Z doping due to its large heat capacity. Although the results seem to suggest that the high-Z doping is only harmful to the implosion performance, our previous work with the two-dimensional RHD simulations indicated that the high-Z doped shell target is effective in the high-density implosion especially for the high-mode perturbation [3]. Moreover, the estimated growth rate of the RTI in the present work denote that the brominated shell is good for the suppression of the hydrodynamic instability because of the longer density scale length and the faster ablation velocity (Fig. 2). Multi-dimensional RHD simulations will be performed to reproduce the realistic perturbation growth.

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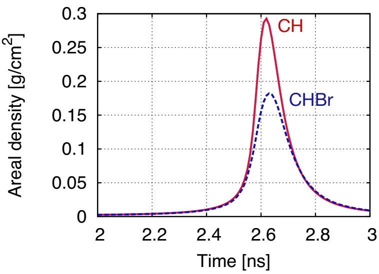

Fig. 1: Temporal history of areal density in the 1D RHD simulations.

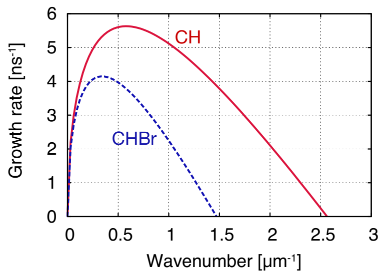

Fig. 2: RTI growth rate predicted by the modified Takabe formula [4].

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