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Forming Smooth Cryogenic Target Layers for OMEGA Direct-Drive ICF Implosions and Prospects for Direct-Drive Targets for the NIF

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More than 100 cryogenic D_2 target ice layers have been formed for direct-drive ICF implosion experiments at LLE. While all of these layers are smooth to several microns rms, some of them have achieved the 1-μm rms nonuniformity required for high-yield implosions. The largest effect on the quality of a cryogenic target layer is the thermal uniformity of the target's surroundings. Temperature nonuniformities at the ice that exceed 100 μK are observable in the layers. Control of the thermal environment determines the uniformity of the ice layer thickness and the time it takes to form the layer. Detailed evidence for this sensitivity and the importance of the thermal environment to the ice quality are presented. The initial direct-drive target design for the NIF is significantly different from the current OMEGA design with the addition of a fill tube and a refracting "Saturn" ring around the target equator (allows direct drive with the NIF x-ray drive beam configuration). Progress at making these targets and a strategy for creating a thermal environment capable of forming high-quality ice layers in these targets will be presented. LLE is modifying its cryogenic systems to perform DT implosions. Transitioning from pure D_2 to mixtures of D_2, DT, and T_2 adds complexity that may affect the ice layer quality. The disparate freezing temperatures of the isotopes may result in partial fractionation with the standard slow-cool protocol used to form a smooth layer. The ability to enhance the layering process using infrared heating may be affected by the inhomogeneity of the isotope concentrations in the ice. These effects are reported for a mixture of H_2, HD, and D_2 that is used as a proxy for D_2, DT, and T_2 mixtures. The status of DT cryogenic operations will be presented. This work was supported by the U.S. Department of Energy Office of Inertial Confinement Fusion under Cooperative Agreement No. DE-FC52-92SF19460. Contributors: M. J. Bonino, T. Duffy, D. H. Edgell, L. M. Elasky, R. Q. Gram, D. Jacobs-Perkins, R. Janezic, S. J. Loucks, L. D. Lund, D. D. Meyerhofer, W. Seka, W. T. Shmayda, and M. D. Wittman, *LLE*.