Forming Uniform Deuterium-Ice Layers in Cryogenic Targets: Experiences Using the OMEGA Cryogenic Target Handling System

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Smooth ice layers in thin-wall plastic shells have been demonstrated

- The smoothest ice layer possessed a roughness of 2.6 μ m (rms).
- Different views of a target yield different roughness power spectra.
- Smoothest ice layers were obtained at a temperature close to the triple point (within 3 mK) with IR power.
 - Determined that precise temperature and achieving the layer smoothness required TWO days.
 - The IR laser power repeatability and stability are main factors affecting the layering time.
- 40% to 60% of the IR layering power is deposited in the deuterated plastic.
- The ice layer is stable once formed (monitored for three days).
- The low-order roughness ($\ell < 5$) is predominant: can be attributed to detachment between the ice and the plastic.



1. The target is backlit with diffused 660-nm light.

2. A bright band in the transmitted image is due to internal reflection from the ice/gas interface



Layering a target, melting it, and re-layering it reveals a repeatable feature that suggests ice/plastic interaction



Rotating the target reveals different roughness power spectra



Optimal layer showed little variation in rms roughness for different viewing angles. Typical ice layer showed greater variation in roughness for different viewing angles.

Large-scale ice roughness is caused by the presence of a void between the ice and the plastic

- Numerical simulations performed using *FLUENT*, a CFD code.
- Other perturbations: Nonuniformity in the thickness of the plastic, non-centering of the target in the layering sphere, and nonuniform temperature distribution of the layering sphere all produce smaller perturbations than observed (the ℓ = 1 perturbation < 1 μ m).



The effect of nonuniform heat resistance between the plastic and the ice on the layer quality requires further study.