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Late-time Radiography of Beryllium Ablators in Long-pulse Gas-filled Hohlraums[1]

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We have obtained the first-ever late-time (>10 ns) radiographs of perturbation growth in a doped beryllium ablator, which is one candidate for the inertial-confinement-fusion capsule ablator at the National Ignition Facility (NIF). To do so, we have designed, deployed, and characterized a 6-ns radiation drive for an Omega hohlraum, filled with methane to inhibit the inward flow of high-Z wall material. The laser drive consists of two separate laser pulse shapes melded together into a uniquely shaped composite. Total input energy is ~4.25 kJ. The radiation drive temperature, characterized by soft x-ray spectroscopy (Dante) and laser Doppler velocimetry, increases to 50 eV in 0.5 ns then gently ramps up to a peak value exceeding 140 eV at 5.6 ns. Side-on x-radiography of the Be sample ejected from the hohlraum provides an additional verification of the drive. Backscatter losses from laser-plasma instabilities into the lens from this surrogate NIF hohlraum are <5%. We find that methane has the desired effect of holding the Au wall back for >10 ns in these experiments. Active and passive shock-break-out diagnostics show that 40-μm thick Be-Cu (0.9% Cu by atom) samples are preheated even with this soft drive with ~1% M-band contribution. Be samples at the rear of the hohlraum have taken the form of both sputtered and powder-pressed planar disks, sinusoids with 100-μm period and 2.5-μm amplitude, and steps (30 and 60 μm thick). This longer-than-average Omega radiation drive approximates conditions expected for the NIF capsule's first shock, where the effects of ablator microstructure are expected to be most significant.

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