Rayleigh–Taylor Growth and Spherical-Compression Measurements of Silicon-Doped Ablators

\[ \lambda = 30 \, \mu m \]

\begin{align*}
\text{OD modulation} & \quad \text{Time (ns)} \\
10^0 & \quad 0 \quad 1 \quad 2 \\
10^{-1} & \quad 0 \quad 1 \quad 2 \\
10^{-2} & \quad 0 \quad 1 \quad 2 \\
10^{-3} & \quad 0 \quad 1 \quad 2 \\
\end{align*}

\begin{align*}
\text{OD modulation} & \quad \text{Distance traveled (\mu m)} \\
100 & \quad 0 \quad 50 \quad 100 \quad 150 \quad 200 \\
10 & \quad 0 \quad 50 \quad 100 \quad 150 \quad 200 \\
1 & \quad 0 \quad 50 \quad 100 \quad 150 \quad 200 \\
\end{align*}

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Si doping reduces ablation-front RT growth

- Silicon doping reduces hard x rays from two-plasmon decay*
- 2-D hydrodynamic simulations of silicon-doped ablator experiments agree with the measured Rayleigh–Taylor (RT) growth
  - experiments with 3% Si-doped CH foils
  - experiments with 6% Si-doped ablators that are planar surrogates for cryogenic implosions
- Measured neutron yields from $\alpha = 2$ warm target implosions increase when silicon is added to the ablator

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Calculations show Si-doped ablators reduce number of fast electrons and RT growth at the ablation surface.

- Laser intensity
  \( I = 8 \times 10^{14} \text{ W/cm}^2 \)

- Calculated implosion velocity
  \( V_i = 3 \times 10^7 \text{ cm/s} \)

- TPD threshold parameter \((\eta)\) reduced

\[
\eta = \frac{I_{14} \cdot L_{\mu m}}{230 \cdot T_{\text{keV}}}
\]

- A high adiabat in the ablation region reduces RT growth.\(^2\)

Ablation-interface RT growth was measured for silicon-doped CH planar foils

- Imposed perturbations
  \[ \lambda = 60 \, \mu m \]
  \[ a_0 = 0.25 \, \mu m \]
  (0.5 \, \mu m p–v)

  \[ \lambda = 30 \, \mu m \]
  \[ a_0 = 0.125 \, \mu m \]
  (0.25 \, \mu m p–v)

Minimized initial shock wave constant acceleration pulse shape
2-D simulations for undoped and Si-doped targets agree with the experimental data.

Ablation-interface RT growth in reduced for 30-μm-wavelength perturbations when Si is added to the CH.
Current planar-RT experiments are surrogates for spherical cryogenic target implosions

- Imposed perturbations
  \[ \lambda = 30 \, \mu m \]
  \[ a_0 = 0.25 \, \mu m \]
  \[ (0.5 \, \mu m \, p-v) \]

  \[ \lambda = 120 \, \mu m \]
  \[ a_0 = 1.0 \, \mu m \]
  \[ (2.0 \, \mu m \, p-v) \]

- RF foam 
  \[ \rho = 180 \, mg/cc \]

- 6% Si-doped CH
Perturbation amplitudes calculated by 2-D hydrodynamic simulations agree with the measured amplitudes.
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Neutron yields and absolute x-ray intensities were measured with spherical target implosions.
The measured neutron yields become closer to simulation as Si thickness is increased.
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Measured neutron yield for $\alpha = 2$ implosions increases when 3 $\mu$m of Si doped CH is added to the ablator.
Summary/Conclusions

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  - experiments with 3% Si-doped CH foils
  - experiments with 6% Si-doped ablators that are planar surrogates for cryogenic implosions
- Measured neutron yields from $\alpha = 2$ warm target implosions increase when silicon is added to the ablator

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