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Plasma Processed Coating of Laser Fusion Targets*

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Laser fusion targets in the near future require coatings uniform to better than 0.1 μm and selectable thickness between 1.0 and 100 μm . These coatings need to be of a variety of materials to offer a wide variability in Z and density for target experiments. The coatings can be applied to a DT fuel container such as a diffusion filled glass shell. These shells must be kept $< 200^\circ\text{C}$ during processing to prevent back diffusion of the fill.

Plasma polymerization has been used to provide some of the materials of interest. To date, this plasma polymerization technique has provided excellent coatings of $\text{CF}_{1.3}$ and $\text{CH}_{1.3}$.^(1,2,3)

Coatings for laser fusion targets have been deposited in an inductively coupled discharge device by plasma polymerization. Two feed gases were used: perfluoro-2-butene, which produced a fluorocarbon coating ($\text{CF}_{1.3}$) with a density of 1.8 g/cc and trans-2-butene which produced a hydrocarbon coating ($\text{CH}_{1.3}$) with a density of 1.0 g/cc. Uniform pin-hole free films have been deposited to a thickness of up to 30 μm of fluorocarbon and up to 110 μm of hydrocarbon.

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The effect of process variables on surface smoothness has been investigated. The basic defect in the coating has been found to result from shadowing by a small surface irregularity in an anisotropic coating flux.⁽⁴⁾

Analysis of the coating defects that result from known irregularities on the substrate has shown that particles of the size, contaminants of the glass shell coating stock and particulates that are generated in the process limit the coating quality. The growth of polymer particles in the gas phase has been eliminated by AM modulation of the RF field to drop particles suspended in the plasma region before they can grow to sufficient size to be a significant defect. Tuning of power, pressure, and monomer flow result in materials that are less brittle and less likely to generate particulates during the process. Ion flux drawn from the discharge and directed to the shells has been very effective at increasing the flexibility of the coatings. This pulsed ion flux also varies charge on the shells and together with a vibrating dish have been very effective in providing reliable and uniform circulation of the shells.

Recently we have been able to levitate a shell on a flow of atoms from a nozzle operating in the free molecular flow region.⁽⁵⁾ Shells which are levitated allow individual processing and help eliminate batch borne particulates.

Coating by the plasma polymerization techniques we have developed provide a wide range of DT filled glass shell mandrels with layers up to 110 μm of hydro or fluorocarbon with ambient surfaces ~ 30 nm and absolute variations in the coating about all 4 π of the shell of ≤ 200 nm.

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