Internal Capsule Defects Quenching Thermonuclear Ignition

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The concept of inertial confinement fusion (ICF) is that a spherical capsule containing a fuel layer is imploded by irradiating its surface with high power lasers or soft x rays, thereby assembling a high-density main fuel and a low-density hot spark, triggering thermonuclear ignition. Hydrodynamic instabilities such as the Rayleigh-Taylor (RT) instability may amplify perturbations on the capsule, and finally mix the cold main fuel and capsule material into the hot spark, thereby quenching thermonuclear ignition.

Surface roughness is generally considered as a primary source of the hydrodynamic instabilities, but internal capsule defects can seed perturbations on the surface, being amplified by the instabilities. Such internal defects are inevitable if capsules are made with coating technique, in which a few (but non zero) monomers of CH get together in flight and fall on the coating surface, making a seed of defects, resulting in cone like structures and domes above them [1] (Fig. 1). The dome is usually polished out to meet a specification of the surface roughness, but the cone structure under the dome remains unpolished.

Our mixing calculations for ignition targets suggests that the internal capsule defects is large enough to quench the thermonuclear ignition, though the initial conditions are not well characterized and so they are assumed to be consistent with the microscopic observations.

Thus it is quite obvious that one should adopt a new target manufacturing technique that can eliminate the internal defects. Density matched emulsion technique [2] is completely free from the internal capsule defects. Backing in late 1980's Osaka group demonstrated extremely high density at time [3] with polystyrene capsules made with this technique. We would urge the ICF community to adopt and improve the density matched emulsion technique to meet the ignition condition.

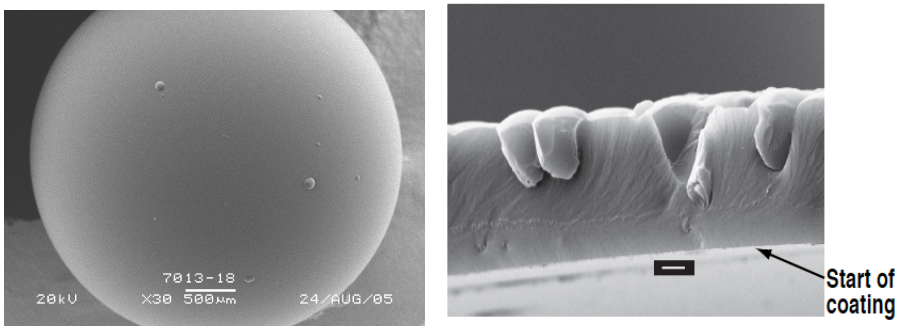

Figure 1: Internal Capsule Defects. Right picture is taken from Ref. [1]

[1] A. Nikroo and D. Woodhouse, "BOUNCE COATING INDUCED DOMES ON GLOW DISCHARGE POLYMER COATED SHELLS", GENERAL ATOMICS REPORT GA-A22869 (1998).
[2] M. Takagi, T. Norimatsu, T. Yamanaka and S. Nakai, J. Vac. Sci. Technol. **A9**, 820 (1991).
[3] H. Azechi et al., Laser and Particle Beams **9**, 193 (1991).