Demonstrating a Target Supply for Inertial Fusion Energy

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A central feature of an Inertial Fusion Energy (IFE) power plant is a target that has been compressed and heated to fusion conditions by the energy input of the driver. The technology to economically manufacture and then position cryogenic targets at chamber center is at the heart of future inertial fusion energy power plants and significant development programs are underway. For direct drive IFE (laser fusion), energy is applied directly to the surface of a spherical CH polymer capsule containing deuterium-tritium (DT) fusion fuel at approximately 18□K. For indirect drive (heavy ion fusion, HIF), the target consists of a similar fuel capsule within a cylindrical metal container or "hohlraum" which converts the incident driver energy into x-rays to implode the capsule. Either target must be accurately delivered to the target chamber center at 5–10□Hz with a precisely predicted target location. The relatively fragile cryogenic targets must survive injection into the target chamber without thermal damage. Future successful fabrication and injection systems must operate at the low cost required for energy production (about \$0.25/target, about 10^4 less than current costs).

Z-pinch driven IFE (ZFE) utilizes high current pulses to compress plasma to produce x-rays that indirectly heat a fusion capsule. ZFE target technologies utilize a repetition rate of approximately 0.1□Hz with a higher yield. The cryogenic targets for ZFE must survive the longer time frame required for placement at target chamber center. Despite the differences, there are important synergisms in target technology between these three proposed approaches to IFE.

This paper provides an overview of the proposed target methodologies for laser fusion, HIF, and ZFE, and summarizes advances in the unique materials science and technology development programs. Demonstrating a credible pathway to an economical target supply is a major part of establishing IFE as a viable energy source. Although much work remains to be done, initial results are promising and suggest that a reliable, consistent and economical target supply can be developed.

□Work supported by US Department of Energy through NRL Contracts N00173-03-C-6010, N00173-03-C-2023 and Contract DE-AC03-98ER54411.