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Synthesis and characterization of diamond capsules for direct-drive inertial confinement fusion

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Abstract

Aiming at improving performance of inertial confinement fusion (ICF) targets, we developed synthesis technology of diamond capsules. In direct-drive ICF for which a spherical target capsule is irradiated directly with intense laser light, laser imprinting due to irradiation non-uniformity on the capsule surface degrades symmetry of the target implosion and performance as a result. We demonstrated that material stiffness is the effective parameter for mitigation of laser imprinting [Kato, *et al*., Phys. Plasmas, submitted (2018)]. In this study, we fabricated polycrystalline diamond capsules as the ablator material of direct-drive ICF targets by using the hot filament chemical vapor deposition method. The capsule (diameter ~500 μm) with sphericity 99.7 %, film thickness <10 μm, and the surface smoothness < 0.1 μm was obtained without mechanical polishing.

1. Introduction

Use of the nuclear fusion has been considered to be one of the promising methods of future energy resources, which generates no carbon dioxide and nuclear wastes at least from the reaction process itself. At present, ITER project is ongoing to confirm primal possibility, in which controlled thermo-nuclear fusion is studied in magnetically confined plasmas [1]. Another possible way to obtain controlled fusion reaction is the internal confinement with high power lasers [2, 3]. In the direct-drive inertial confinement fusion (ICF), a fuel capsule is irradiated directly with the laser light. The capsule consists of a cryogenic layer of deuterium and tritium (DT) frozen onto the inner surface of a spherical shell of