Diamond capsules improve performance of laser fusion

August 9 2018

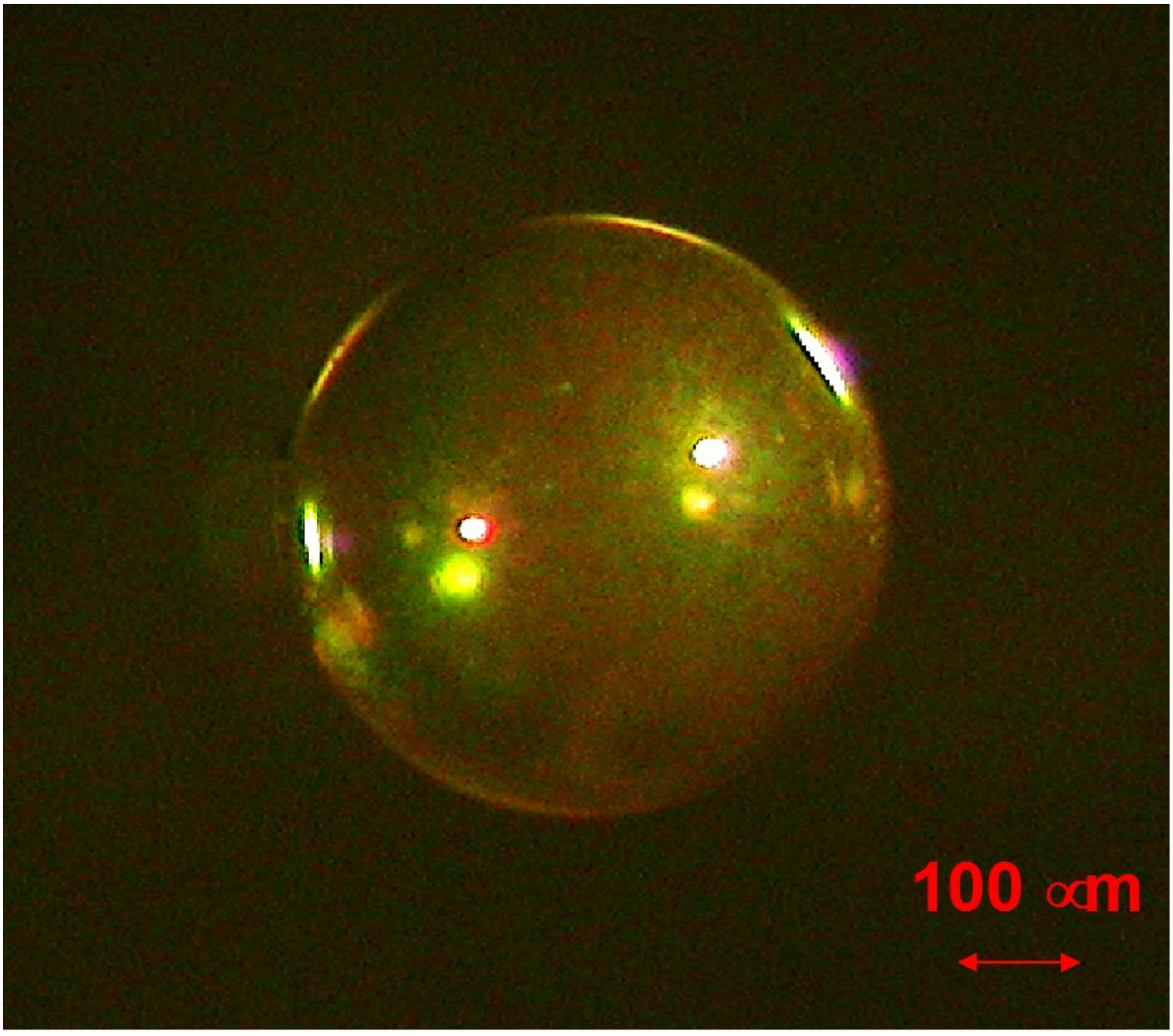

Figure 1. Diamond capsule for nuclear fusion made using the chemical vapor deposition (CVD) method (Diameter: ~500 μm, film thickness

Osaka University-led researchers demonstrated that the perturbation of laser imprinting on a capsule for nuclear fusion fuel made from stiff and heavy materials was mitigated. Using the latest chemical vapor deposition (CVD) method, they also produced high-precision diamond fuel capsules, a key technology applicable for fusion fuel.

When initiating nuclear fusion reactions by compressing a fuel target in the form of a capsule, perturbation of laser imprinting due to irradiation non-uniformity grows on the surface of the capsule. In inertial confinement fusion (ICF), a fuel capsule is irradiated directly with laser beams, so laser imprinting by laser irradiation and the surface roughness of a capsule are major issues because they prevent compression and heating of fuel.

In this study, the researchers first tried to mitigate laser imprinting. Paying attention to the fact that diamond is stiff but exhibits high elasticity under ultra-high pressure of 100 GPa, they performed basic experiments and simulations regarding the influence of material stiffness and density on mitigation of imprint perturbation. As a result, it was clarified that the perturbation of laser imprinting on the surface of a diamond capsule was reduced to approximately 30 percent of that of polystyrene, a conventional capsule material. These research results were published in *Physics of Plasmas*.

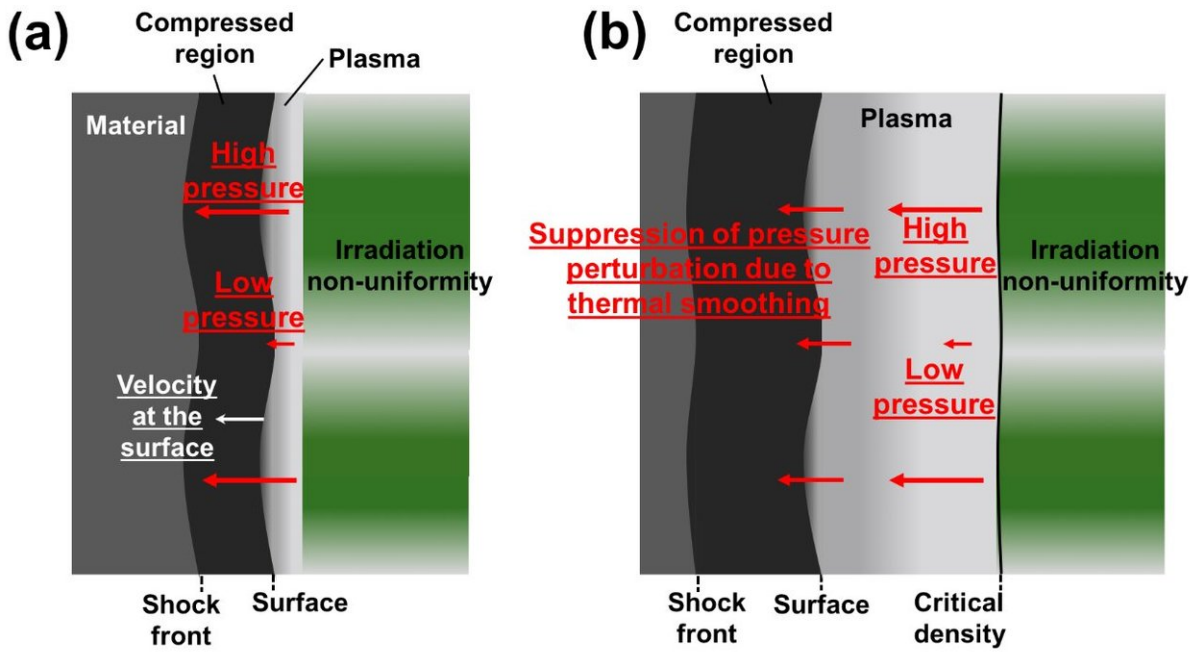

Figure 2. Schematic illustration of laser imprinting. (a) Immediately after laser irradiation. (b) Plasma grows on the target surface with time. Credit: Osaka University

Furthermore, researchers from the Institute of Laser Engineering, Osaka University and the National Institute of Advanced Industrial Science and Technology (AIST) fabricated highly uniformed diamond capsules with surface smoothness (