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The Study of Fabrication High Z coatings by Magnetron Sputtering for ICF Target

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Fusion promises to offer a clean, inexpensive, efficient, and abundant source of energy for future. As we all know, Inertial Confinement Fusion (ICF) is an alternative way to achieve ignition and utilize fusion energy. In ICF experiment, high-Z materials are needed to improve the implosion and lead to more energy release, or yield, from the target. Among different high-Z materials, as a high-atomic number (high-Z) and refractory material, tungsten has attracted great interest for its potential use in ICF, due to its excellent thermal and electrical properties [1-3].

In this paper we report the development of tungsten coatings to produce high Z shells focusing on production, surface morphology and uniform properties of tungsten shells. Through surface modification and deposition adhesion layer on running pan, the crack problems of the tungsten film on running Pan were solved successfully. By reducing the adhere force between mandrel and Pan, the surface morphology of the tungsten shells was improved. By controlling the sputtering heat effect, we successfully fabricated tungsten shells on PAMS mandrels. The copper atoms with appropriate amounts were found to form a supersaturated solid solution with tungsten, which can serve to refine the grains of these coatings and to smooth their surface.

We are able to control the tungsten coating rate and therefore coating thickness. We could routinely produce uniform 5-10μm tungsten coatings both on PAMS mandrels, SiO2 mandrels and GDP mandrels with a Δwall≤0.2μm. Typical surface roughness values for coated shells having a 2μm tungsten coating were 30 to50 RMS, while surface roughness values for coated shells having a 5μm tungsten coating were 80 to 100 RMS. Though drill 20μm diameter hole on tungsten coating (PAMS mandrel) by ns laser, and annealed at 310℃ in vacuum, we can get hollow tungsten shells without PAMS mandrel successfully.

Besides tungsten coating, we also give an introduction and progress for fabrication of all kinds of metal coatings and films by magnetron sputtering in Laser Fusion research center.

References

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