§47. Development of Aluminum Cone Tip for Fast Ignition Experiment

Koga, M. (Graduate School of Engineering, Univ. Hyogo)

In fast ignition, the role of corn is very important to guide hot electrons to imploded core plasma for heating. Recently, many researchers have reported that hot electrons were diverged more than expected.[1) 2)]. It is concerned that hot electrons are scattered by high-Z plasma generated from gold cone target.[3)] This may cause the drop of the energy coupling of the heating laser to hot electrons. Therefore, low-Z materials are drawing attention as cone materials. Moreover, some simulation studies suggest the possibility for the hot electron beam guiding by the self-generated magnetic field by using pointed type cone (Tongari cone). In this study, we develop the method to fabricate an aluminum cone tip to attach the conventional gold cone in order to confirm above mentioned interesting characteristics of the low Z cone. Although microfabrication techniques of aluminum have been already existed, its cost is too high to apply them to the commercial reactor. So we propose a laser CVD method. Figure 1 shows the schematic diagram of laser CVD system. We use trimethylaluminum (TMA) as a chemical precursor of aluminum. Because of its explosive nature in the air, we depressurize the whole system and use argon gas which contains TMA by bubbling as the reaction gas. This reaction gas is heated by a laser irradiation in the reaction chamber. TMA is thermally decomposed when it is heated above 300 degrees and become aluminum. The products were observed by a digital zoom microscope and a scanning electron microscope by changing the reaction conditions such as gas flow rate and laser power. Component of products were analyzed by energy dispersive X-ray spectroscopy (EDX).

Figure 2 shows an example of EDX images of deposited aluminum blob. Gas pressure was 3 Pa, laser power was 10 mW and irradiation time is 30 minutes. It is clearly seen that small aluminum blob is fabricated. By changing the reaction gas pressure, it was found that higher pressure was better for fabrication. Moreover, continuous gas flow condition was better than sealed gas condition. We think the thermal convection is encouraged by gas flow and results in the smooth aluminum deposition. By changing the laser power and irradiation time, it was found that there were threshold value to generate aluminum. And too long irradiation time and too high laser power seemed to ablate deposited aluminum. Therefore, there must be optimum values. Now we are looking for this optimum values.

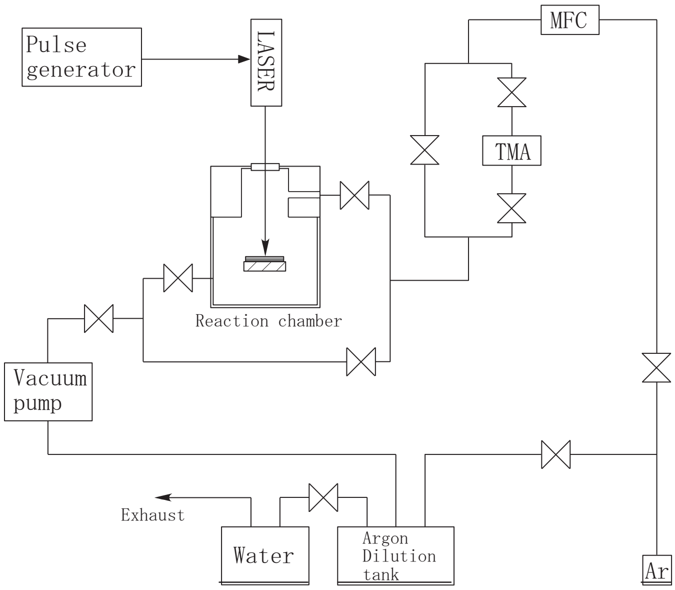

Fig. 1. Schematic diagram of laser CVD system.

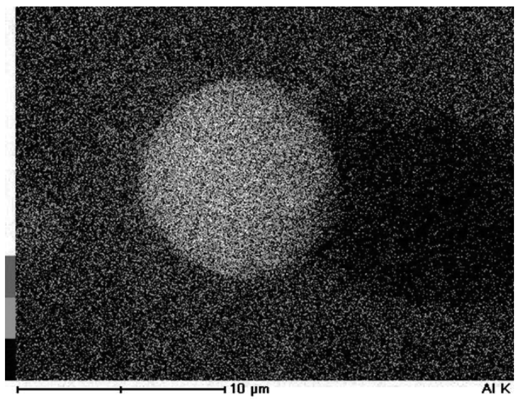

Fig. 2. EDX image of deposited alminium blob.

1) Green, J. S. et al.: Phys. Rev. Lett., **100** (2008) 015003.
2) Akli, K. U. et al.: Phys. Rev. E **86** (2012) 026404.
3) Johzaki, T. et al.: Plasma Phys. Control. Fusion **51** (2009) 014002.