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Preparation of Silicon Ultrafine Nanosize Particles for Light Emission Devices

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Rapid growth of pulsed power technology makes it possible new applications, which were not possible by conventional technologies. If we transfer the pulsed power energy to pulsed ion beams such as protons, wider applications have been possible. For example, the interaction of pulsed proton beam with target produces very high density plasma because the range of protons is very small compared with electrons. Here, the range is the distance, where the beam stops by loosing its energy due to interaction with targets. For example, the range of protons in aluminum target is estimated as 14 m, while that of electron 1.5 mm. The short range of protons gives a huge energy density on target, resulting in high-density ablation plasma.

By the irradiation of proton beam with aluminum target, we have typically obtained the plasma density on the order of $\sim 10^{20}$ cm^{-3}. Depositing the ablation plasma on a substrate placed nearby, we succeeded in the efficient preparation of various thin films such as YBaCuO, $SrTiO_3$, $BaTiO_3$, $(Ba,Sr)TiO_3$, B_4C, ZrO_2, ITO, Poly-Si, which was called pulsed ion beam evaporation (IBE)[1-3].

Such the ablation plasma, in addition, has been used to synthesize ultrafine nanosize particles(UNP) by the rapid cooling of the plasma with ambient gas[4,5]. Various kinds of UNP have been successfully synthesized such as Al_2O_3, AlN, TiO_2, and TiN. In this study, since these details were also published, we will present recent interesting results of poly-silicon particles, which emit light emission of blue. Although silicon does not emit light because of its indirect transition, it is known that light emission might be available from nanosize particles of silicon possibly due to quantumized confinement. From such a viewpoint, we will present light emission

from UNP of poly-silicon. Here, UNP was produced by the rapid cooling of the ablation plasma obtained by IBE.

[References]

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