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ZnO nanoparticles generated by RF sputtering with laser-assisted

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Zinc oxide (ZnO) is a versatile wide bandgap semiconductor for transparent conductors, piezoelectrics, and short wavelength light emitting devices. Since ZnO has a band gap of 3.3 eV and high exciton binding energy of 60 meV, it is also used for UV laser. The exciton binding energy of ZnO is more than twice that of GaN, which improves the laser oscillation at room temperature and the reliability of the optical device. [1]. In this way, ZnO is an attractive material in terms of quantum dots [2]. Recently, methods for producing nanoparticles have been investigated and many examples using lasers for the synthesis of nanoparticles have also been reported [3]. In this study, we succeeded in producing ZnO nanoparticles on ZnO thin film by using laser during RF sputtering of ZnO.

Figure1 shows the experimental setup of RF sputtering system with laser. ZnO film was deposited on a-plane sapphire substrate at an Ar flow rate of 8 sccm. We used 13.56 MHz RF sputtering of a counter electrode. The target power was 100 W and the substrate temperature was 400 °C.

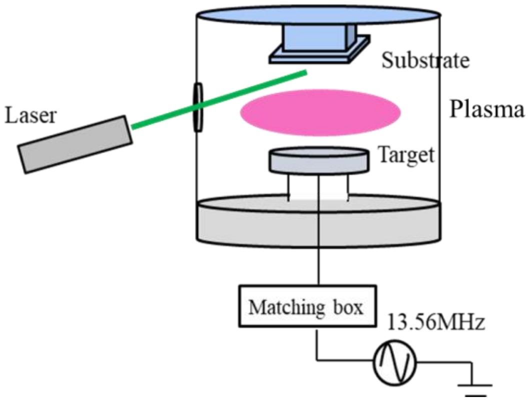

Figure1 Schematic diagram of experimental setup

The deposited samples were analyzed by SEM, and the average of the particle diameter was obtained the SEM images. Figure 2 shows an SEM image obtained by irradiating the laser with wavelength of 532nm for 30 seconds. The mean of particle diameter, which is minimum Feret's diameter, is about 20nm and number density is 48.4/μm^2 in the figure. The particle does not cohere and is monodispersion. In addition, the dependence of particle size on laser irradiation time are shown in Figure3. Error bars represent standard deviation of particle size. The laser power is about 80mW. The particle mean size becomes larger as the irradiation time is lengthened during 3 minutes. When it exceeds 3 minutes, the average particle diameter settles down about 30 nm. Dependence of particle diameter on wavelength is examined through wavelength of 532, 650 and 785 nm with an hour irradiation. Experimental result is that nanoparticles, whose mean size is 30nm, can be generated by using a laser with wavelength of 532 nm and 785 nm. On the other hand, nanoparticles were not formed at the wavelength of red 650 nm. We would like to mention detailed procedures and results in the presentation.

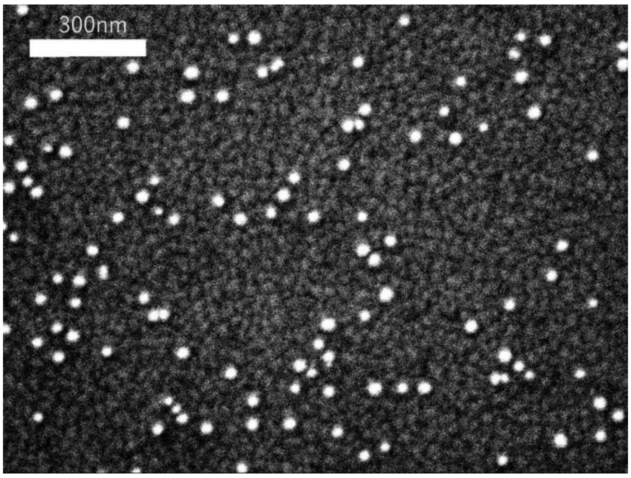

Figure 2 SEM images of ZnO nano particles

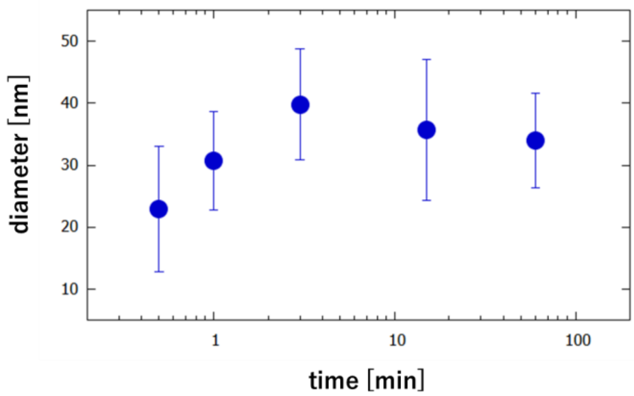

Figure 3 The dependence of particle diameter size on laser irradiation time

References
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