論文 / 著書情報
Article / Book Information

題目(和文)	
Title(English)	Study on silicon nanoparticle formation by laser ablation in liquid
著者(和文)	P.CHEWCHINDA
Author(English)	Pattarin Chewchinda
出典(和文)	学位:博士（工学）, 学位授与機関:東京工業大学, 報告番号:甲第9992号, 授与年月日:2015年9月25日, 学位の種別:課程博士, 審査員:和田　裕之,小田原　修,吉本　護,北本　仁孝,中村　一隆
Citation(English)	Degree:Doctor (Engineering), Conferring organization: Tokyo Institute of Technology, Report number:甲第9992号, Conferred date:2015/9/25, Degree Type:Course doctor, Examiner:,,,,
学位種別(和文)	博士論文
Category(English)	Doctoral Thesis
種別(和文)	要約
Type(English)	Outline

Thesis outline

Silicon nanoparticles have drawn much attention from researchers owing to their size-dependent properties, abundance, and non-toxicity. They can be applied into a broad range of applications varies from bioimaging to electronic device. To prepared silicon nanoparticles, laser ablation in liquid is considered as one of the promising technique due to its simplicity and product purity. However, the properties of synthesized particles strongly depend on experimental conditions. Therefore, a study on the effect of experimental parameters on the formation of particles is essential. In this work, the effect of laser wavelength, energy density, and ions are studied.

Chapter 1 “General introduction”: This chapter focuses on the applications of silicon nanoparticles in bioimaging and photovoltaic device. In addition, general mechanism and recent progress on laser ablation in liquid are also discussed.

Chapter 2 “Laser wavelength effect on silicon nanoparticles formation by laser ablation in ethanol”: In this chapter, silicon nanoparticles are prepared by laser ablation in ethanol. The target is either irradiated with Nd:YAG laser at first or second harmonic generation (1064 or 532 nm, respectively). The result indicates that shorter laser wavelength can prepare smaller particles with higher yield than those prepared at longer wavelength. This effect is due to the better absorption of silicon target at shorter wavelength, which provides more energy to generate particle. According to nucleation and growth theory, high solute concentration results in small nuclei. Therefore, owing to higher yield, laser wavelength of 532 nm provides smaller particles than those prepared by laser wavelength of 1064 nm.

Chapter 3 “Energy density effect on silicon nanoparticles prepared formation by laser ablation in ethanol and their application in quantum dot-sensitized solar cell”: In this chapter, silicon nanoparticles are prepared by laser ablation in ethanol and the laser energy density was varied from 0.15 to 0.45 J/cm^2. The result shows that particle productivity increases with laser energy density owing to an increase in optical absorption heat at the target. In addition, particle size reduction is observed as laser energy density enhances. This phenomena occurs because higher particle yield leads to large amount of small nuclei, according to nucleation and growth theory. In addition, laser fragmentation possibly occurs at high laser energy density, which also leads to small particles. Those prepared particles are further utilized for the fabrication of quantum dot-sensitized solar cell. The addition of silicon nanoparticles is proved to enhance the device efficiency compared with the one without them.

Chapter 4 “Inorganic salt effect on silicon nanoparticles formation by laser ablation in electrolyte solution”: In this chapter, silicon nanoparticles are prepared by laser ablation in three different electrolyte solution. The results indicates that particle size and stability can be tuned by the addition of inorganic salt at suitable concentration.

Chapter 5 “General Conclusions”: This chapter summarizes the overall outcomes of this study and perspectives for future research.