Control of carbon nanofibers configuration on glassy carbon by two-step ion beam irradiation method

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Carbon nanofibers (CNFs) and carbon nanotubes (CNTs) are new carbon-based materials. However, the production of CNFs and CNTs is very difficult due to the complicated processes and high temperature involved. Therefore, a method of fabrication is required that enables high throughput at a low cost. Our previous study reported that CNFs were formed using a two-step ion beam irradiation method at room temperature[1]. The two-step ion beam irradiation method is as follows. First, oxygen ion beam irradiates to glassy carbon (GC) substrate, and then nano-scale conical structures were formed[2]. After the formed the conical structures, argon ion beam irradiates to this sample by oblique angle, and then, CNFs are formed on GC surface by diffusion of carbon atoms[3]. In addition, this CNFs includes multi-wall carbon nanotube.

Our previous study reported that length of CNFs were around 2.5 μm. However, this length is not enough to fiber use. In this study, we examined the formation condition of CNFs, in particular, higher ion energy was used for argon ion beam.

Figure 1 shows SEM image growth of CNFs after argon ion beam irradiation. The fabrication procedure of CNFs is as follows. Oxygen ion beam energy of 500 eV to GC forms the finest pitch of conical anti-reflection (AR) structures. After the fabrication of AR structures, irradiation of argon ion (Ar^+) beam changes the surface morphology and oblique angle irradiation can form the CNFs. Ar^+ beam energy of 2000 eV and irradiation time of 15 min can fabricate CNFs grow on the tip of the conical AR structures. CNFs grow on the tip of the conical AR structures made by oxygen ion beam irradiation using argon beam oblique irradiation. Fabricated CNFs diameters were 15-20 nm and lengths were 5-15 μm.

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[3] M. Tanemura et al., Appl. Phys. Lett. 84 (2004) 3831.

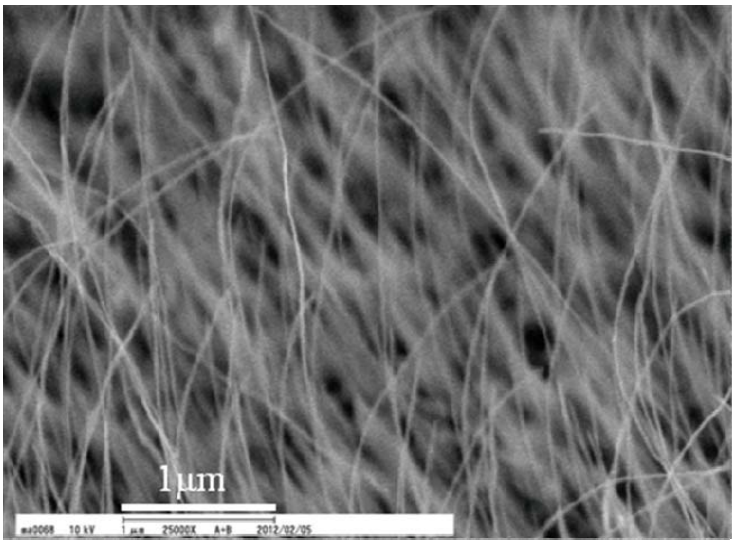

Figure 1: SEM image growth of CNFs after argon ion beam irradiation.