Futurum
Tsukuba Science Journal

Carbon materials

Electrochemical Polymerization of Bithiophene Using Carbon Film Electrode from Polyaniline

Aohan Wang, Hiromasa Goto*

Division of Materials Science, Faculty of Pure and Applied Sciences, University of Tsukuba, Tsukuba, Ibaraki 305-8573, Japan.

ABSTRACT

Carbon films were obtained during carbonization of polyaniline at 900 °C under argon atmosphere in a gold furnace. Carbon films attaching on the inside wall of the quartz tube were peeled off by using a scotch tape. We used these carbon films as an electrode to conduct polymerization of conducing polymers.
Keywords: carbonization, polyaniline, electrode

1. Introduction

Carbon materials have attracted remarkable attentions due to the unique properties.[1] Graphene and graphite with sheet structures are good materials for large area products requiring conductivity.[2,3] Several methods to synthesis thus material have been investigated.[4] Organic compounds are suitable carbon source to produce carbon materials.

In this study, we report a carbon film obtained during carbonization of polyaniline at 900 °C in the argon atmosphere. We also verified the possibility of carbon film as an electrode. Carbon film was assembled to a cell for electrochemical polymerization. Polybithiophene were synthesized by using thus fabricated cell.

2. Experimental

2.1 Synthesis of polyaniline

Aniline as a monomer (100 g) and (+)-10-camphorsulfonic and (CSA) (50 g) were dissolved in 3000 mL water at 0 °C for 30 min. Ammonium peroxodisulfate (APS) (200 g) were then added into the mixture reaction solution. After 24 hours, polyaniline was filtered and dried in vacuum.

2.2 Carbonization of polyaniline

Polyaniline was carbonized at 1000 °C for five hours in argon atmosphere in a gold furnace. After cooling down to temperature, some metallic materials showing metallic reflection were found in the quartz tube and inside wall of chamber.

2.3 Fabrication of a carbon film electrode.

The metallic carbon film attached on the inside wall of the chamber can be easily peeled off by using a scotch type. Then the scotch type was cut into a 1.5 cm ×1.5 cm sheet. The scotch tape sheet were then sticked on a plastic board to fabricate an electrode.

2.4 Electrochemical polymerization using the carbon film electrode.

Polybithiophene were synthesized using the carbon film electrode. As shown in Figure 1, two carbon film electrodes were used as cathode and anode, respectively. 0.01 M bithiophene monomer were added in to 0.1 M tetrabutylammounium perchlorate/acetonitrile solution to adjust the electrolyte solution. Thus prepared electrolyte solution were injected into the cell and 4 V was applied for 10 min.

Received: 10 September, 2016. Accepted: 6 December, 2016
*E-mail: gotoh@ims.tsukuba.ac.jp

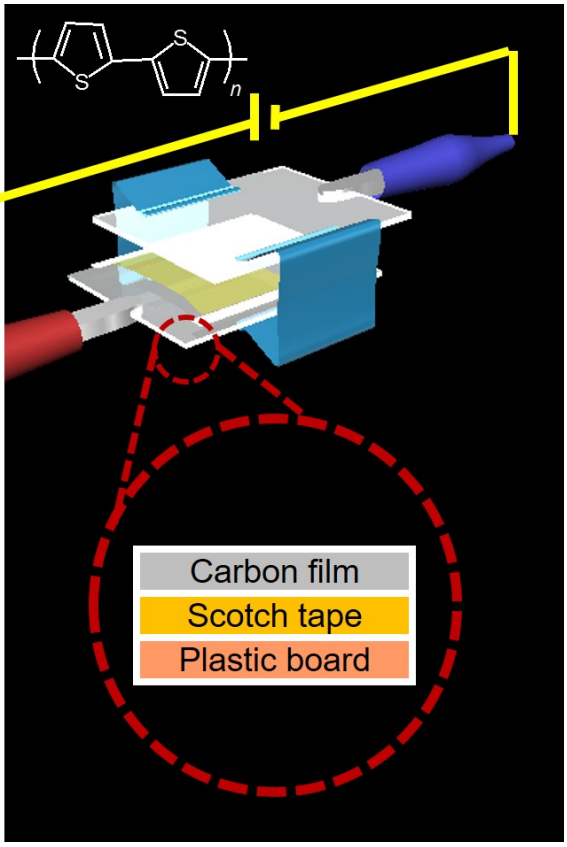

Figure 1. Image of electrochemical polymerization of using carbon film based electrode.

3. Results and discussion

Carbon film surface and the obtained polybithiophene film were observed under scanning electron microscopy (SEM). Figure 2 (a) is the image of the carbon film which was peelde off from the chamber by using a scotch tape. The surface of this carbon film is very smooth. Figure 2 (b) shows image of polybiophene deposited on the carbon film based electrode. Compared with Figure 2(a), many aggaragates was found on the surface. These aggaragates are polybithiophene. This result suggests that the carbon film obtained during carboniztion of polyailine can work as an electrode.

4. Conclusions

Carbon film obtained during carbonization of polyaniline shows good conductivity. Thus obtained film can be applied to flexible electrode in the future.

Acknowledgments

A part of this work was supported by NIMS microstructural characterization platform as a program of "nanotechnology Platform" of the Ministry of Education, Culture, Sports, Science and Technology (MEXT), Japan.

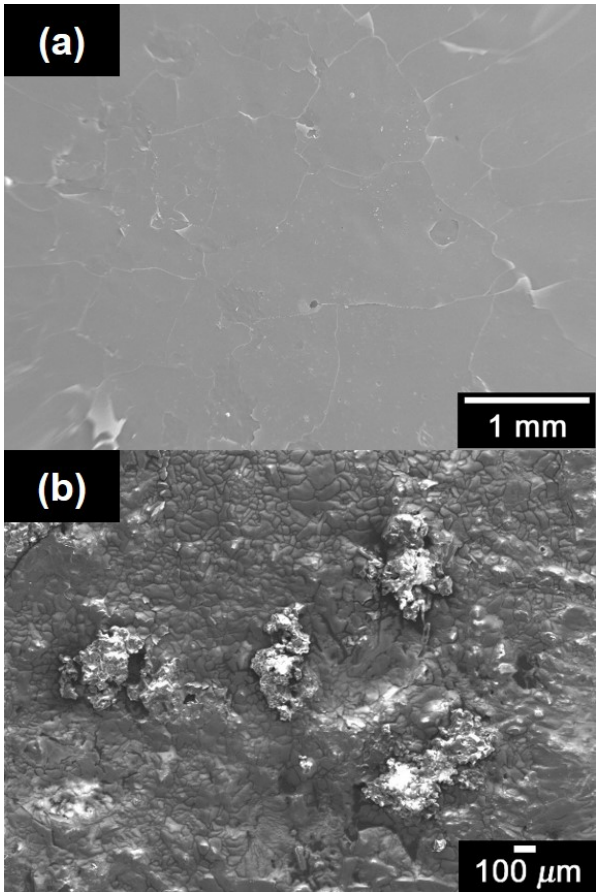

Figure 2. SEM image of (a) carbon film, (b) polybithiophene deposited on the carbon film based electrode.

References

1. A.G. Pandolfo, and A.F. Hollenkamp. Carbon properties and their role in supercapacitors, Journal of Power Sources, 157, page 11-27 (2006).
2. X. Li, W. Cai, J. An, S. Kim, J. Hah, D. Xing, *et al.*, Large-area synthesis of high-quality and uniform graphene films on copper foils, Science, 324, page 1312-1314 (2009).
3. S. Chae, F. Güneş, K. Kim, E. Kim, G. Han, Soo. Kim, *et al.*, Synthesis of large-area graphene layers on poly-nickel substrate by chemical vapor deposition: wrinkle formation, Advanced Materials, 21, page 2328-2333, (2009).
4. K.S. Novoselov, V.I. Fal'ko, L Colombo, P.R. Gellert, M.G. Schwab and K. Kim. A roadmap for graphene, Nature, 409, page 192-200 (2012).