

課題番号 : F-15-HK-0036
利用形態 : 機器利用
利用課題名(日本語) : 和周波発生分光法によりカーボン膜表面における溶媒吸着の研究
Program Title(English) : The Investigation of Solvents on the Carbon Film by Sum Frequency Generation
利用者名(日本語) : 彭奇齡, 叶深
Username(English) : Qiling Peng, Shen Ye
所属名(日本語) : 北海道大学 触媒科学研究所
Affiliation(English) : Institute for Catalysis, Hokkaido University

1. 概要(Summary)

Li-ion batteries are widely used in portable electric devices due to their high capacity and output voltage.¹ Recently, more research interests have been focused on the structure of the electrode / solution interface in Li-ion batteries, where the electrochemical reaction takes place and can significantly affect the reversibility and the capacity fading cycling. Mixed carbonate electrolytes, comprised of cyclic carbonate and one or more linear carbonates, doped with Li-salt is one frequently used for the commercial Li-ion batteries. To understand the electrode surface structure in the Li-ion battery, we have investigated the structure of the solvent adsorption on the LiCoO₂ cathode surface by using a surface-sensitive vibrational spectroscopy, sum frequency generation (SFG).^{2,3} In the present study, SFG vibrational spectroscopy has been employed to investigate the adsorption state of solvents on the carbon film surface in non-aqueous solution. We hope the structural information will be helpful to understand the formation of solid electrolyte interface (SEI) on the anode electrode surface, which plays an important role for the Li-ion battery.

2. 実験(Experimental)

【利用した主な装置】

Reactive ion Etching (RIE-10NR)

【実験方法】

Firstly, the CaF₂ surface is treated by using Ar RIE plasma (RIE-10NR). Secondary, the chamber of carbon coater was evacuated to only ca.1 Pascal. Then, a thin carbon film was deposited onto the CaF₂ surface by a thermal evaporation in a vacuum carbon coater (VC-100, Japan) using a carbon source of a pencil tube (Hi-uni B 0.5, Mitsubishi Pencil).

3. 結果と考察(Results and Discussion)

The thickness of the carbon film was approximately 35 nm, determined by an atomic force microscope, AFM (MFP-3D-BIO, Asylum Research). Figure 1 shows the SFG spectrum of PC solvent in contact with the carbon film. The SFG measurements showed that the solvents take some

ordered adlayer structures on the carbon film because of its surface-sensitivity. Two SFG peaks are observed based on the fitting processes. One is located at 1778 cm⁻¹ close to that in the bulk, and the other is observed at 1830 cm⁻¹. Similar peaks were observed on the LiCoO₂ surface.² It is interesting to note that these two modes have reversed phase, implying that PC may take two reversed adsorption geometries on the carbon film.

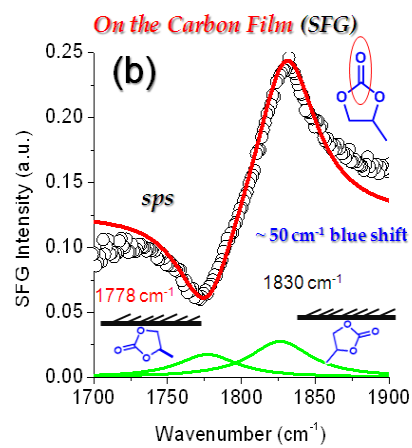


Fig. 1 the SFG spectra of PC on the carbon Film

4. その他・特記事項(Others)

・参考文献

- (1) K. Xu, *Chem.Rev.* **104**, 4303 (2004).
- (2) H. Liu, Y. Tong, N. Kuwata, M. Osawa, J. Kawamura, S. Ye, *J. Phys. Chem. B.* **113**, 20531(2009).
- (3) L. Yu, Y. Wang, N. Kuwata, M. Osawa, J. Kawamura, S. Ye, *Anew. Chem. Int. Ed.* **52**, 5753(2013).

5. 論文・学会発表(Publication/Presentation)

- (1) 彭奇齡, 大澤雅俊, 叶深. 炭素薄膜表面における有機溶媒分子の吸着構造の解析. 電気化学会第82回大会. 横浜. 2015
- (2) 彭奇齡, 喬琳, 大澤雅俊, 叶深. SFG分光法による炭素-電解質溶液界面の構造研究. 第9回分子科学討論会. 東京. 2015

6. 関連特許

なし

