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Lithium insertion characteristics of carbonized Sugi (Cryptomeria japonica) wood sintered under high pressure

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Much attention has focused on the development of negative electrode for lithium-ion batteries using nanostrutured carbons that have high storage capacity [1-3, Figure 1], as intrinsic irreversible capacity and high hysteresis have limited their practical application [4, 5]. The present paper reports on the effects of temperature during carbonization treatment, particle size and sintering conditions on the lithium insertion characteristics of the wood-based material.

Sugi (Cryptomeria japonica) wood was first carbonized in an electric furnace at 500ºC and 700°C under argon at a heating rate of 4 ºC/min. The carbonized wood was then sintered under vacuum in a pulse current sintering apparatus at up to 1050°C for 15 min. The resulting carbon material was investigated in a two-electrode cell against metallic lithium using 1 M $LiPF_6$ in EC/DEC as the electrolyte. The effects of textural and chemical characteristics of the material on electrochemical performance, including reversible and irreversible capacities, and cycleability, were analysed.

Our data showed a beneficial effect of optimizing the parameters such as the precarbonization treatment, the material particle size and the sintering process on improving the electrochemical performance of lithium cells. The materials sintered under high pressure showed a decrease in their irreversible capacity compared with materials prepared with a binder on a Cu foil. Although wood char is generally considered to consist of hard carbons, the galvanostatic characteristics of sintered carbons are very similar to those of soft carbons. The most effective sample (having the lowest irreversible capacity and highest reversible capacity) was prepared at 700°C with a particle size of 45-63 μm before sintering under pressure. Future studies will examine the porous texture of these materials in performing N_2 adsorption at 77K, in order to understand the effect of pressure during sintering and to further optimize their electrochemical performance.

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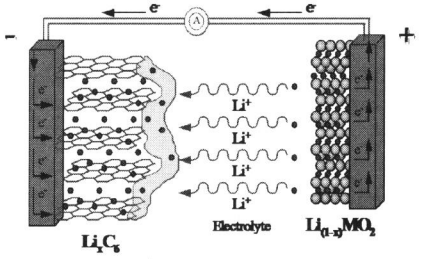

Figure 1. Electrode reactions in lithium ion cells.

References

[1] Dominko, R., M. Gaberŝĉek, J. Drofenik, M. Bele, S. Pejovnik, *Electrochemical and Solid-State Letters* 4(11) (2001) A87-A190.

[2] Letellier, M., F. Chevallier, C. Clinard, E. Frackowiak, J.-N. Rouzaud, F. Béguin, *Journal of Chemical Physics* 118(13) (2003) 6038-6045.

[3] Béguin F., F. Chevallier, C. Vix-Guterl, S. Saadallah, V. Bertagna, J.N. Rouzaud, E. Frackowiak. *Carbon* 43 (2005) 2160-2167.

[4] Frackowiak E., F. Béguin, *Carbon* 40(2002) 1775–1787.

[5] Béguin F., F. Chevallier, C. Vix, S. Saadallah, J.N. Rouzaud, E. Frackowiak, *Journal of Physics and Chemistry of Solids* 65 (2004) 211–217.