Catalytically Derived Battery Graphites

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In industry, primary synthetic graphites (PSGs) for Li-ion batteries are usually produced by heat treatment of soft carbon precursors (*e.g.* coke) at high temperatures (3000 °C). The high temperature processing accounts for a significant proportion of the total manufacturing cost. Catalytic graphitization presents another method to prepare PSGs at much lower temperatures.[1-2] In this work, we report the synthesis of PSGs via the catalytic graphitization of soft carbon (needle coke) with a Mg catalyst at low temperatures. The catalytically derived graphite displays excellent electrochemical performance in Li half cells.

Figure 1(a) shows the XRD pattern of the soft carbon precursor, which is typical of amorphous carbon with broad peak. Figure 1(b) shows the XRD pattern of the catalytic graphite made at 1000 °C, which is characteristic of a highly-ordered graphite. Only graphite phase is shown in Figure 1(b), indicating the Mg catalyst has been completely removed.

The electrochemical performance of catalytically synthesized graphite was tested by cycling in coin-type Li half cells at C/5 rate. The cycling performance and voltage curve are shown in Figure 1(c). The reversible capacity of the catalytically synthesized graphite is close to the theoretical value of graphite. This high reversible capacity and obvious staging phenomenon is indicative of a high degree of graphitization and low content of turbostratic disorder.[3] The observed high reversible capacity is comparable to battery grade commercial graphites, and is rarely observed for artificial graphite made at 1000 °C.

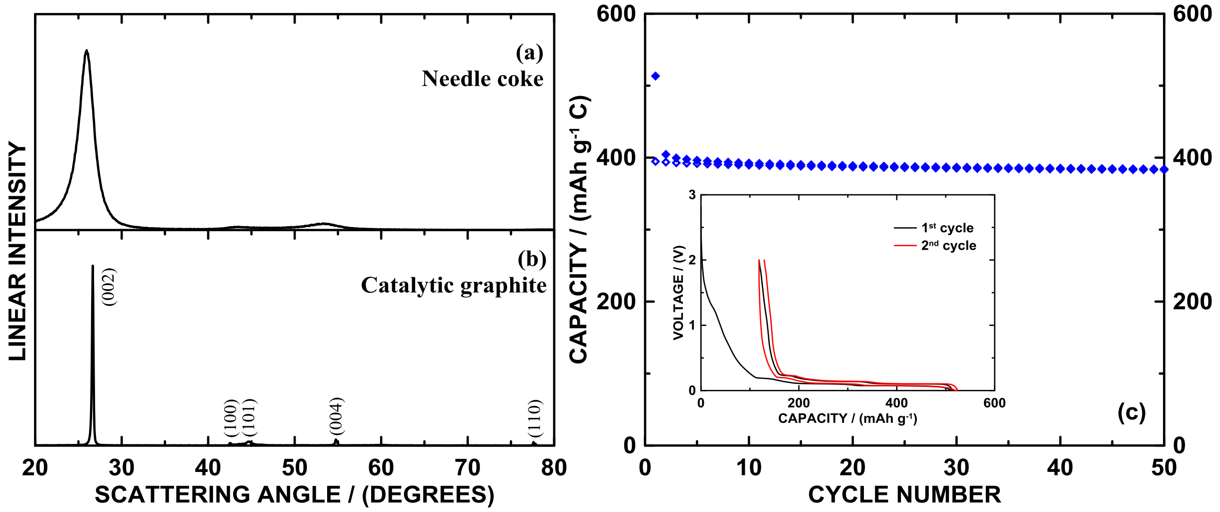

Figure 1 XRD patterns of (a) needle coke and (b) catalytically derived graphite. (c) Cycling performance and voltage curve of catalytically derived graphite.

References:
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[3] J.R. Dahn, T. Zheng, Y. Liu, J.S. Xue, Science 270 (1995) 590–593.