Effects of Carbon Structure and Surface Oxygen on the Carbon's Performance as the Anode in Lithium-Ion Battery Determined

Four carbon materials (C1, C2, C3, and C4) were tested electrochemically at the NASA Glenn Research Center at Lewis Field to determine their performance in lithium-ion batteries. They were formed as shown in the figure. This process caused very little carbon loss. Products C1 and C3 contained very little oxygen because of the final overnight heating at 540 °C. Products C2 and C4, on the other hand, contained small amounts of basic oxide. The electrochemical test involved cycles of lithium intercalation and deintercalation using C/saturated LiI-50/50 (vol %) ethylene carbonate (EC) and dimethyl carbonate (DMC)/Li half cell. The cycling test, which is summarized in the table, resulted in three major conclusions.

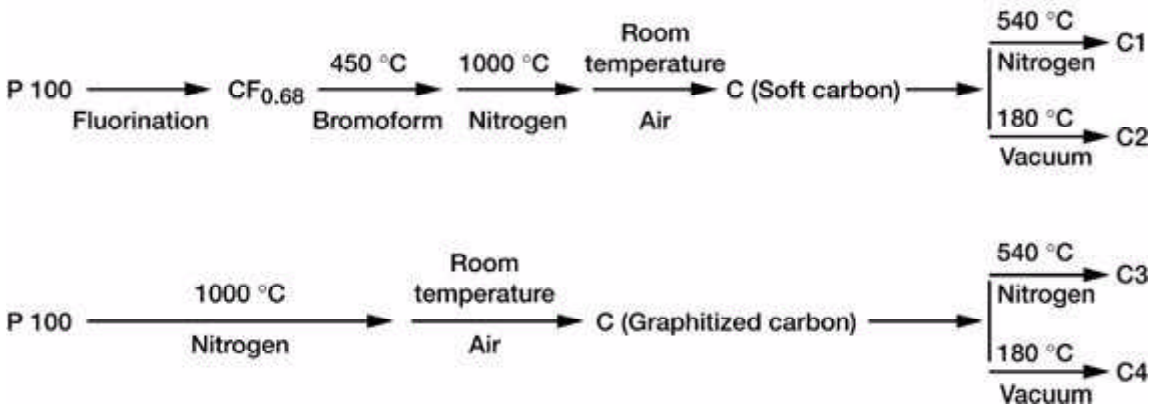
1. The capacity of the carbon with a basic oxide surface converges to a constant value quickly (within 4 cycles), possibly because the oxide prevents solvent from entering the carbon structure and, therefore, prolongs the carbon's cycle life.

2. Under certain conditions, the disordered carbon can store more lithium than its precursor.

3. These samples and their precursor can intercalate at 200 mA/g and deintercalate at a rate of 2000 mA/g without significant capacity loss.

CAPACITIES OF THE CARBON MATERIALS TO STORE AND RELEASE LITHIUM

	Capacity, mA-hr/g					
	1st cycle		4th cycle		High current density (After more than four cycles)	
	Intercalation 10 mA/g	Deintercalation 10 mA/g	Intercalation 10 mA/g	Deintercalation 10 mA/g	Intercalation 200 mA/g	Deintercalation 2000 mA/g
C1	487	280	288	268	---	---
C2	310	208	197	197	161	163
C3	249	223	224	219	---	---
C4	257	245	245	244	194	232



Preparation of carbon samples.

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