CHEMISTRY LETTERS, pp. 361-364, 1993.

The Surface Modification of Graphite Particles by Direct Fluorination

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The dispersion stability of graphite particles in water was largely increased by a surface modification of direct fluorination. The fluorinated graphite particles in water did not flocculate and kept stable suspension for long time, and it was found that the surface of fluorinated graphite particles became more hydrophilic and was highly polarized in water.

Recently, it was found that the wettability of carbon fiber was largely increased by direct fluorination at room temperature.[1] This paper reports an application of the previous modification of carbon materials by direct fluorination.

The graphite is one of sparingly wettable materials to water. After the graphite particles (LGV-1988, Lonza Ltd.) on the nickel plate were put into the fluorination reactor, the system was evacuated for one hour, and then fluorine gas was introduced at a constant pressure of 10, 50, 100, or 300 mmHg, respectively. After the reaction for 10 min at room temperature, the fluorine in the system was replaced by nitrogen. Each sample taken out was fully washed with water, and dried in a vacuum. After fluorinated graphite particles were dispersed in water, the time dependence of sedimentation of the particles was

examined, and the dispersion/flocculation of particles was observed through an optical microscope. In addition, the surface properties of fluorinated graphite particles were investigated by measuring water adsorption and zeta potential in water.

The sedimentation appearances of various fluorinated graphite particles in water after standing for 3 hours are shown in Fig.1. The original graphite particles (A) were settled in a short time and the supernatant of dispersion became clear, while the fluorinated graphite particles treated at 50, 100 and 300 mmHg (samples C, D, and E) kept stable suspension for long time. In the observation through a microscope, for the particles of sample A flocculation occurred in water, while the particles of samples C, D and E showed no flocculation. To compare the dispersion/flocculation of particles in water, microphotographs of samples A and D are shown in Fig.2.

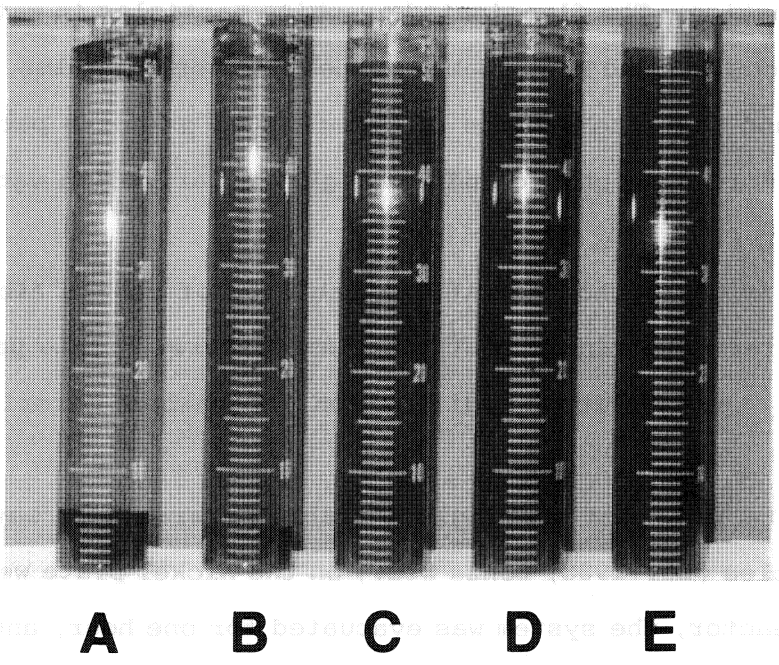

Fig. 1. Effect of direct fluorination on the dispersion stability of graphite particles in water.
A, Graphite particles; B, Fluorinated graphite particles at 10 mmHg; C, Fluorinated graphite particles at 50 mmHg; D, Fluorinated graphite particles at 100 mmHg; E, Fluorinated graphite particles at 300 mmHg.

Water adsorption isotherms shown in Fig.3 indicate that the adsorbed amount of water on graphite particle surfaces is increased by direct fluorination. The zeta potential of graphite particles in water shown in Fig.4 increases negatively by direct fluorination. These results suggest that the surface of fluorinated graphite particles becomes more hydrophilic and is highly polarized in water. Therefore, it is considered that the enhancement of dispersion stability of graphite particles treated by direct fluorination in water is due to the changes of such surface properties, being probably caused by C-F ionic bond on the surface.[2] The detailed surface analysis associated with the effect of direct fluorination on the dispersion stability of graphite particles in water is in progress.

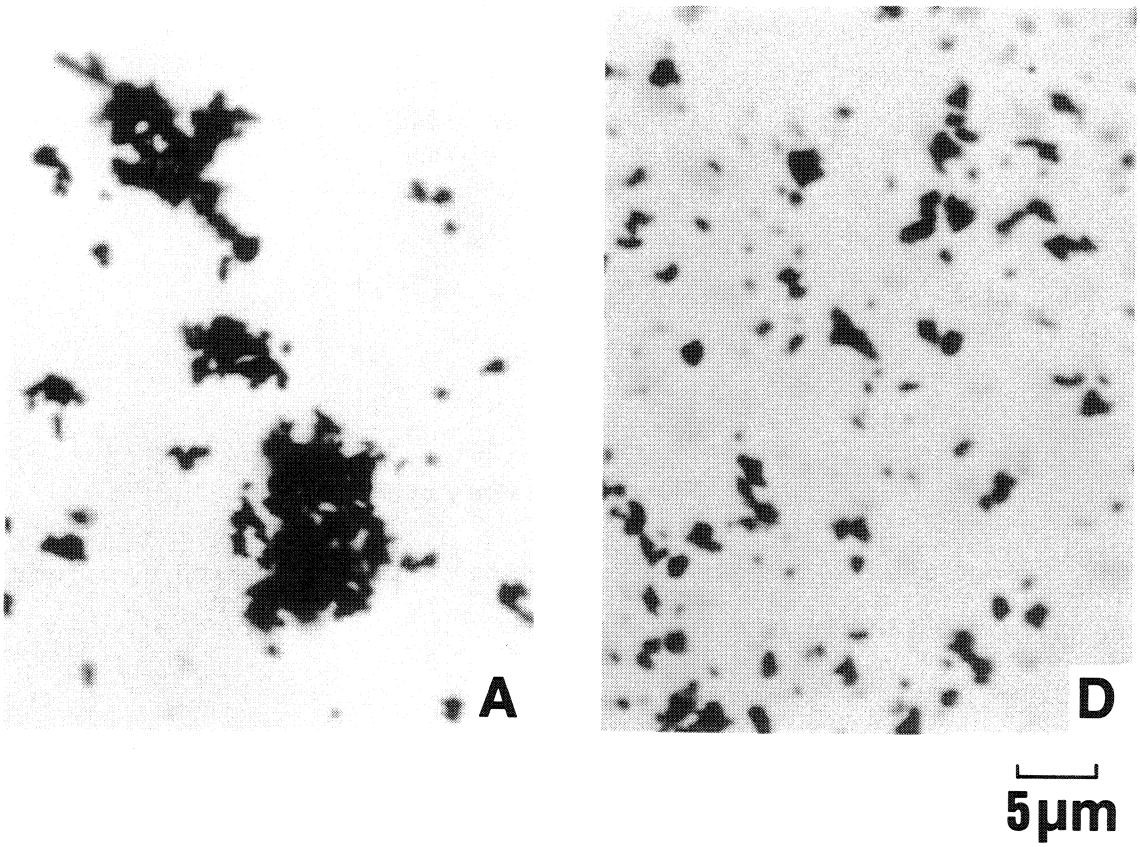

Fig. 2. Dispersion of graphite particles (A) and fluorinated graphite particles (D) in water.

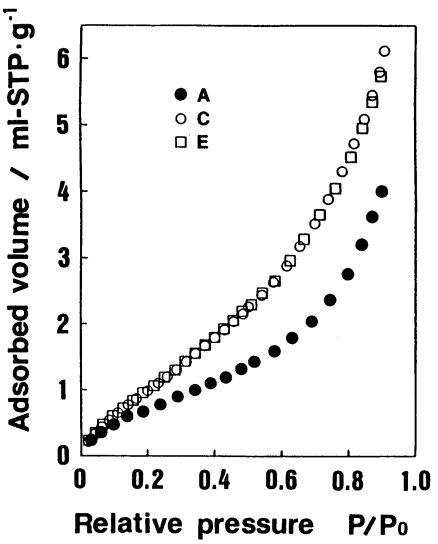

Fig. 3. Water adsorption isotherms of graphite particles and of various fluorinated graphite particles at 25 ℃.

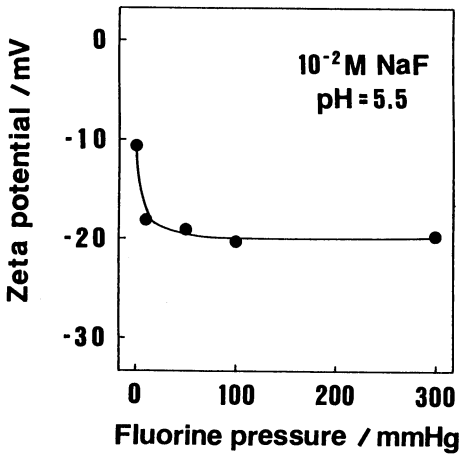

Fig. 4. Change of zeta potential of graphite particles treated by direct fluorination in 10^{-2}M NaF solution.

References

1)Y. Chong and H. Ohara, J. Fluorine Chem., 57, 169(1992).

2)T. Nakajima, M. Molinier, and M. Motoyama, Carbon, 29, 429(1991).

(Received November 27, 1992)