Synthesis of Ordered Mesoporous Carbons with Channel Structure from an Organic–Organic Nanocomposite

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The discovery of nanostructured carbon materials such as fullerenes and carbon nanotubes has led to a considerable interest in the development of various carbonaceous materials. The most common synthetic route yielding ordered mesoporous carbons (OMCs) involves a multi-step synthetic procedure, in which ordered mesoporous silicas are employed as hard templates.

In contrast, our novel OMC synthesis route avoids the use of hard templates, and could reduce the number of the preparation steps and the cost involved in producing these materials. Our strategy is to use an organic–organic interaction between a thermosetting polymer and a thermally-decomposable surfactant to form a periodic ordered nanocomposite. The thermosetting polymer is carbonized by heating under N₂, after which process it remains as a carbonaceous pore wall. Resorcinol-formaldehyde (RF) and triethyl orthoacetate (EOA) were used as a carbon co-precursors and triblock copolymer Pluronic F127 was used as a surfactant (Fig. 1C).

Fig. 1 Formation of ordered mesoporous carbon.

Fine Control of Red-Green-Blue Photoluminescence in Zeolites with Incorporated with Rare-Earth Ions and a Photosensitizer

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We have constructed rare earth ion-exchanged zeolites with incorporation of a photosensitizer (Figure 1a), which exhibit successful rainbow-colored photoluminescence (Figure 1b). The colors are varied from violet (b) to red (j) through blue (c, d) and green (e) continuously by changing the amounts of the rare earth cations, and the type of the sensitizer (4-acetylbiphenyl or benzophenone). 4-Acetylbiphenyl encapsulated in the zeolite cavity affords blue emission in addition to red and green colors emitted by Eu(III) and Tb(III), leading to simultaneous photoluminescence in RGB. The intensity ratio of the three color components is varied depending on the wavelength of the excitation and the temperatures as shown in Figure 2 a) 77 K and b) 293 K. Thus, we can tune the photoluminescence color in a very wide range by changing the amounts of the rare earth cations and an organic photosensitizer at a stage of the material design (b-j in Figure 3), and also by changing the temperature and the excitation wavelength at a stage of utilization (lines A and B in Figure 3) as shown in CIE x-y chromaticity diagram.

Fig. 2 FE-SEM images of ordered mesoporous carbon.