Supporting Information

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Organic-inorganic mesoporous nanocarriers integrated with biogenic ligands

Jinlou Gu, Wei Fan, Atsushi Shimojima and Tatsuya Okubo*

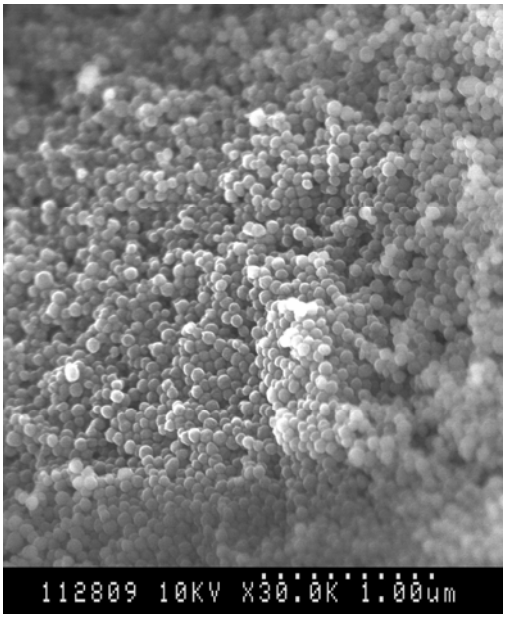


Figure S1. SEM image of smaller mesoporous nanosphere with particle size *ca.* 50-80 nm.

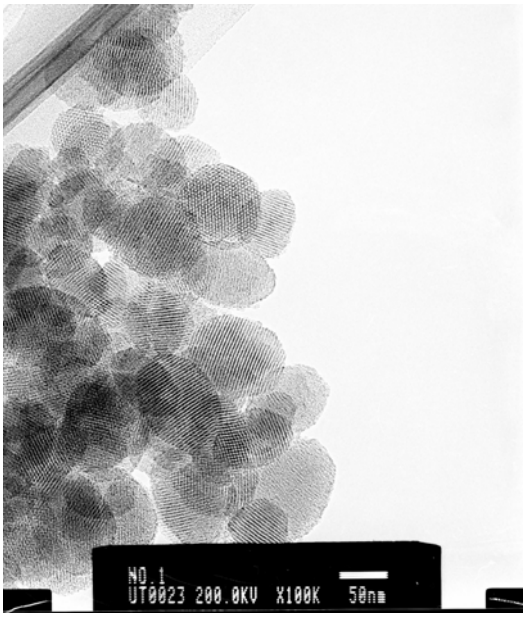


Figure S2. TEM image of the smaller mesoporous nanosphere synthesized with APS ratio to TEOS more than 20 wt %.

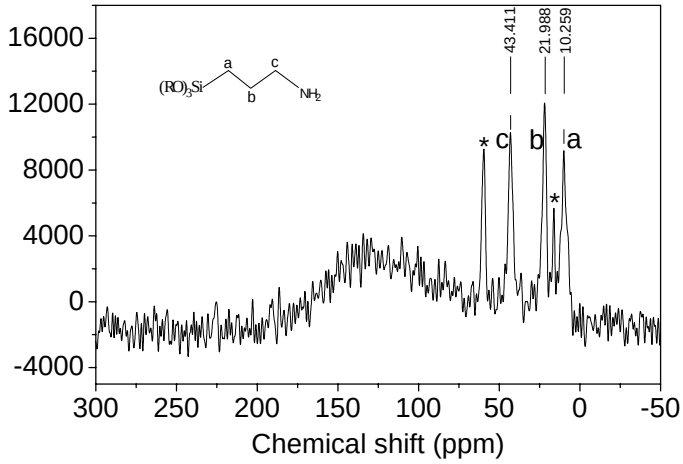
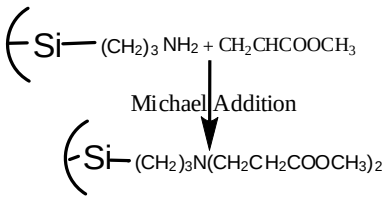


Figure S3. Solid-state ^{13}C cross-polarization (CP)/MAS NMR spectrum of the as-synthesized MNPs modified with organic group. The spectra were recorded on a JEOL JNM- CMX-400 spectrometer at a resonance frequency of 100.53 MHz with a contact time of 1.5 ms and a recycle delay of 5 s. The samples were put into 5 mm zirconia rotors and spun at 5 kHz. Note that the broad peaks (70-190 ppm) should be due to the Teflon caps of the sample tubes. Signals of ethanol at ~18 ppm and ~58 ppm as labeled with stars are due to surface adsorption from the extraction and washings.

1. Michael addition reaction details.

1.0 g of MNPs was placed into a flask, then 10 mL of MeOH and 1.0 g of methyl acrylate (MA) were added, and the mixture was stirred with a magnetic stirrer at 323 K for at least 24 h. After the reaction, the mixture was centrifuged at 20000 rpm and any precipitated colloidal silica was dispersed in methanol and centrifuged again. The procedure was repeated until no more MA was detected in the supernatant solution. The reaction was schemed as following.



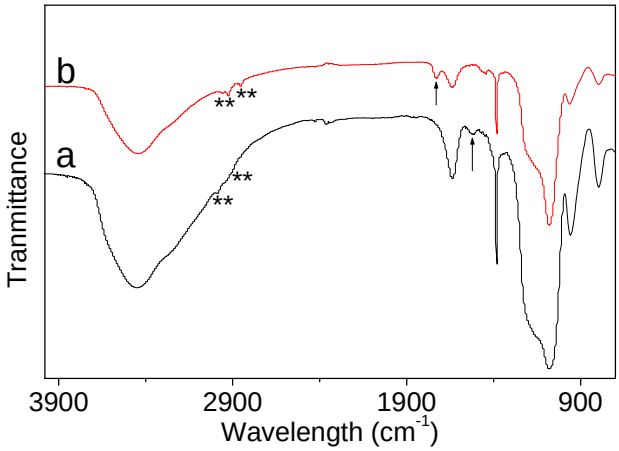


Figure S4. The FT-IR spectra of extracted hybrid MNPs (a) with NH_2 groups and (b) after Michael addition reaction.

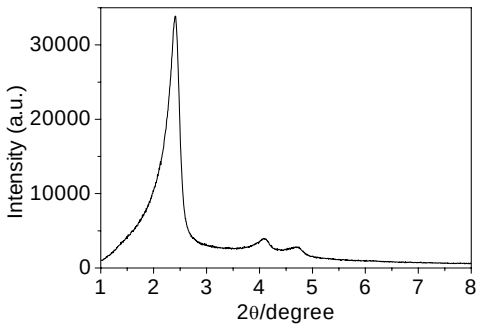


Figure S5. The XRD pattern of MNPs after Michael addition reaction.

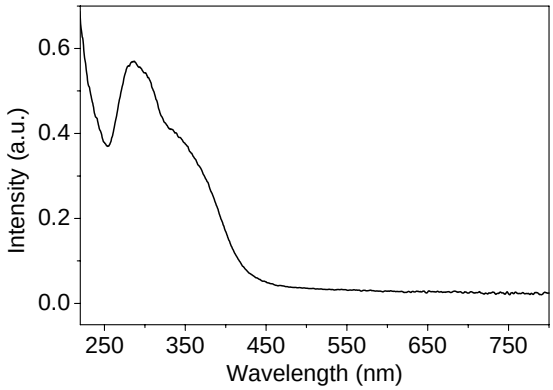


Figure S6. Absorption spectrum of composite MNPs modified with FA.

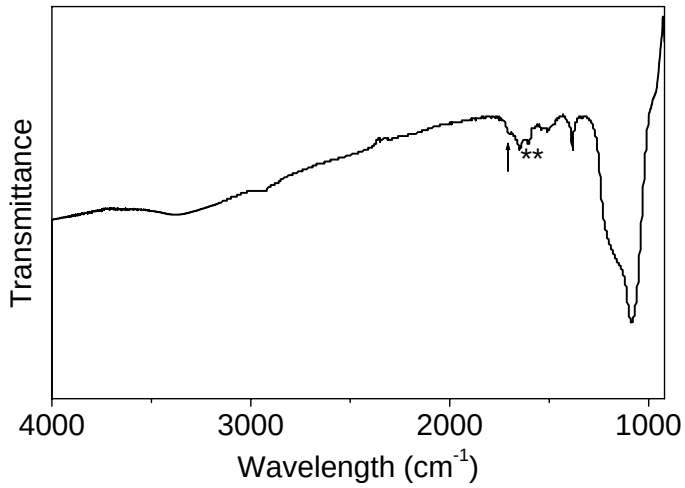


Figure S7. The FT-IR spectrum of composite MNPs with FA modified. The distinct N-H bending vibrations of the –CONH- were present as labeled with stars. An obvious absorption peak at 1704 cm^{-1} for the C-O stretching of carboxyl group was also observed as labeled with arrow.

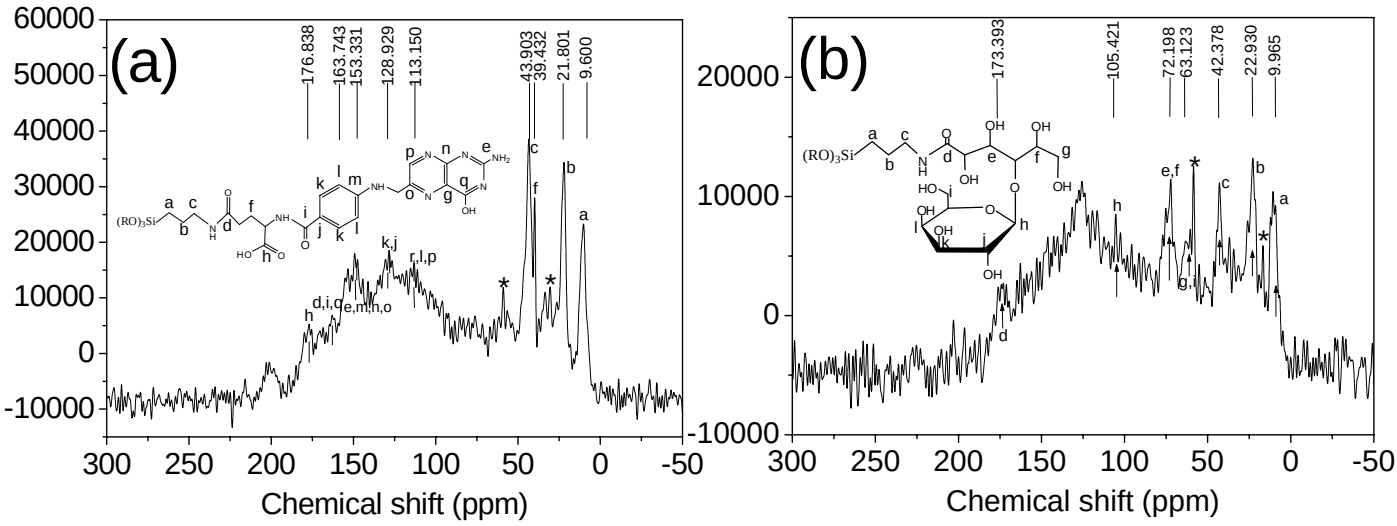


Figure S8. Solid-state ^{13}C cross-polarized (CP)/MAS NMR spectra of the composite MNPs modified with (a) FA and (b) LA; the important and typical carbon signals were labeled with numbers. The broad backgrounds are due to the Teflon caps of the sample tubes. Signals of ethanol at ~18 ppm and ~58 ppm as labeled with stars are due to surface adsorption from the extraction and washings. The broad and strong peak centered at 72.198 ppm for Figure S8 (b) are the sum of a series of hydroxyl carbon of e, f, j, k, l positions.

2. Link pyrene to the inner surface of MNPs to demonstrate the reaction activity after the outer surface functionalization.

Pyrene functionalization was easily prepared by dissolving 1-pyrenebutyric acid N-hydroxysuccinimide ester in 20 mL of DMF solution with 0.25 g of MNPs with FA modification dissolved at 353 K for 24 hours. After the reaction, the mixture was centrifuged at 20000 rpm and any precipitated colloidal silica was dispersed in methanol and centrifuged again. The procedure was repeated until no more pyrene was detected in the supernatant solution.

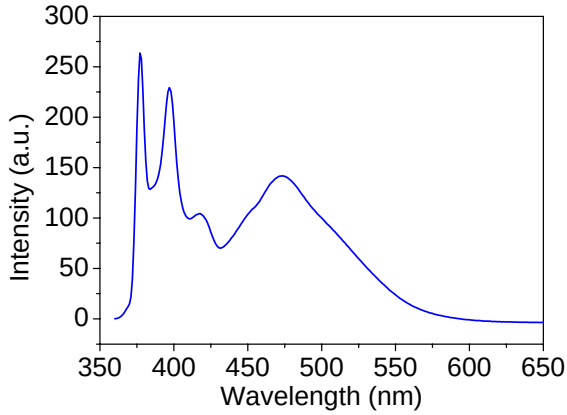


Figure S9. The fluorescence spectrum of the synthesized composite MNPs with pyrene linked into the inner surface while outer surface were modified with LA.