Supplementary Material (ESI) for Chemical Communications

Supplementary Information for

Controlled Synthesis of Nanorods/Nanorings of a Novel Co-Cu Complex in Microemulsion at Room Temperature

Genban Sun[a,b], Minhua Cao[c], Yonghui Wang[c], Changwen Hu[*,a, b,c], Ling Ren[a,b], Kunlin Huang[a,b]

[a]The Institute for Chemical Physics, Beijing Institute of Technology, Beijing, P. R. China, 100081.

[b]Department of Chemistry, School of Science, Beijing Institute of Technology, Beijing, P. R. China, 100081.

[c]Institute of Polyoxometalate Chemistry, Northeast Normal University, Changchun, P. R. China. 30024.

E-mail: cwhu@bit.edu.cn; Tel (Fax): +86-10-82571381.

1. Additional analyses of Infrared Absorption Spectra showing the composition of the Co-Cu complex nanorods and nanorings.

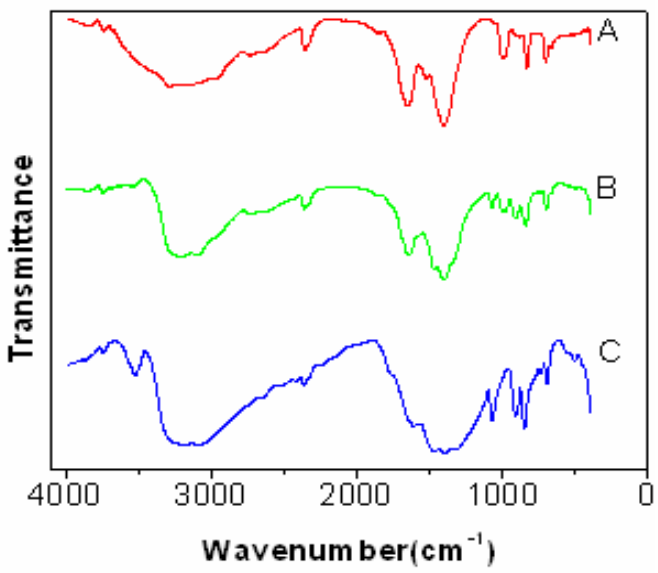

Figure S1 FT-IR spectra of the nanorods(A), nanorings(B) and the bulk $Co(NH_3)_6]_3$-$[Cu_4(OH)(CO_3)_8]\cdot 2H_2O$(C).

The Fourier Transform Infrared (FTIR) spectra of the Co-Cu complex nanorods, nanorings, and the bulk $[Co(NH_3)_6]_3[Cu_4(OH)(CO_3)_8]\cdot 2H_2O$ are shown in Figure S1. The spectral peaks provide vibrational information for the functional groups in the samples, which is very important for characterizing the structure and composition of the materials. From Fig S1, it can be clearly seen that there is nearly a one-to-one correspondence of the major peaks among the spectra of the Co-Cu complex nanorods, nanorings and the bulk Co-Cu complex. In addition, the peak positions are also close in spite of small shifts. This indicates that the functional groups and structures are similar in the three materials. The small spectral shifts may be caused by the change from an fcc structure to a nanostructure. We conclude that $[Co(NH_3)_6]_3[Cu_4(OH)(CO_3)_8]\cdot 2H_2O$ has six characteristic peaks: the stretching vibration of O-H (3700-3650 cm^{-1}), the stretching vibration of O-H in the crystallization water (appearing at 3540 cm^{-1}), the symmetric stretching vibration of N-H (3500-2600 cm^{-1}), the stretching vibration of C=O (2400 cm^{-1}), the bending vibration of O-H (1600 cm^{-1}), and the bending vibration of N-H (1500-1300 cm^{-1}).

2. The result of thermal analysis.

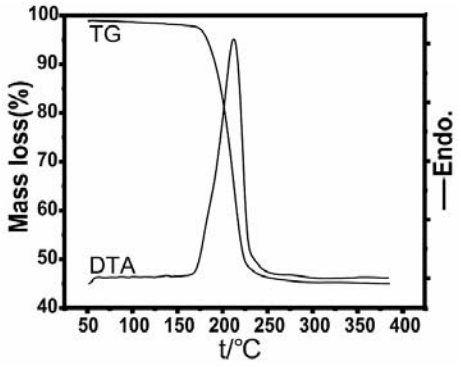

Figure S2 TG and DTA curves of the Co-Cu complex nanorods

TG and DTA curves of the nanorings are similar to those of the nanorods. The molecular formula of this compound is $[Co(NH_3)_6]_3[Cu_4(OH)(CO_3)_8]\cdot 2H_2O$, and its molecular weight is M1=1269.79. Then from Figure S2 it can be clearly known that the crystallization water in the complex was stripped down at 120 ºC and the WT (%) = -2.2%, in good agreement with the theoretic value. The process from 120 ºC (entirely losing the water of crystallization) to 300 ºC, the complex was oxidized and decomposed into Co_2O_3 and CuO. This weight losing was about -55.1% and the theoretic value was -55.36%. Bsed on the analyses of XRD patterns, FT-IR spectra and TG-DTA curves, it is reasonable that the molecular formula of the complex is $[Co(NH_3)_6]_3[Cu_4(OH)(CO_3)_8]\cdot 2H_2O$.

3. The effect of *w* and *t* on the morphologic formation of the Co-Cu complex nanomaterials (Here, the "*w*" is [H_2O]/ [surfactant] molar ratio in the system; "*t*" is the time of the reaction).

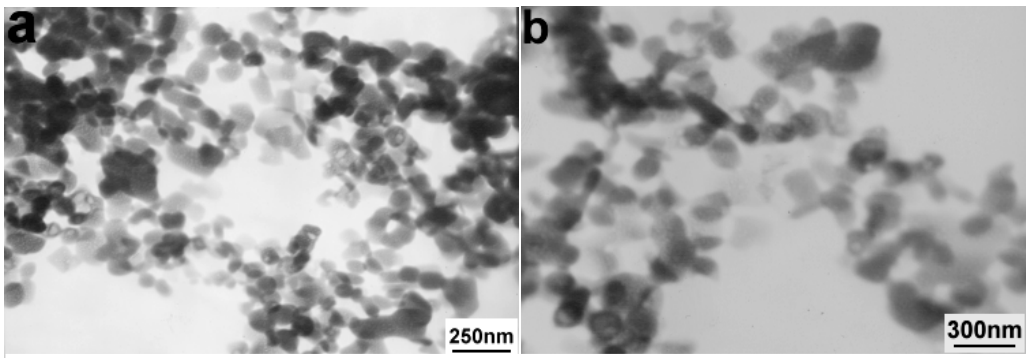

Figure S3 The TEM images of the different parts of the products obtained with *w* = 35 and *t* = 24 h

Under this condition, only nanoparticles were obtained and their diameters were about 50 nm. This indicated that there was no micelle structures formed in the system, and the just microemulsion was round in shape.

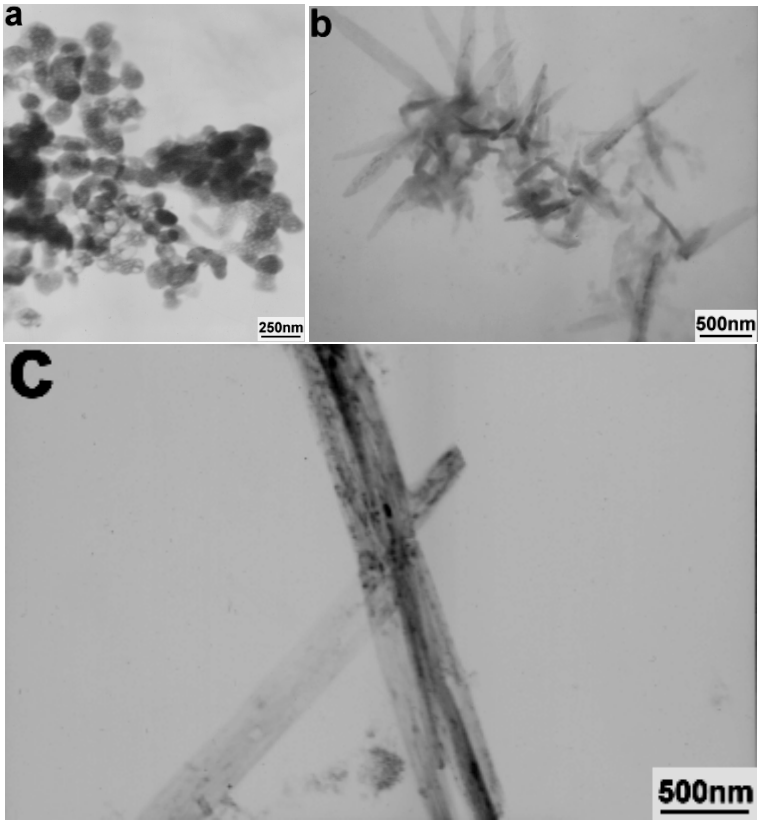

Figure S4 The TEM images of the products obtained with $w = 40$ and (a) $t = 1$ h, (b) $t = 12$ h, (c) $t = 24$ h

Keeping $w = 40$ constant, we changed the reaction time as $t = 1$ h (a), 12 h (b) and 24 h (c). The result (see figure S4) was shown as follows: Figure 4a ($t = 1$ h) shows the morphology is spherical; Figure 4b ($t = 12$ h) indicates a short needle-like morphology with a diameter of 80 nm and a length of 500 nm, respectively; from Figure 4c ($t = 24$ h) nanorods can be observed with 100 nm in diameter and 2-3 μm in length. It is assumed that when $w = 40$, the microemulsion may form a circular micro-reactor, and with the nucleation and growth of the crystal a circular micro-reactor can change into a rod-like structure because the required number of charge compensating cations remarkably increases as well.

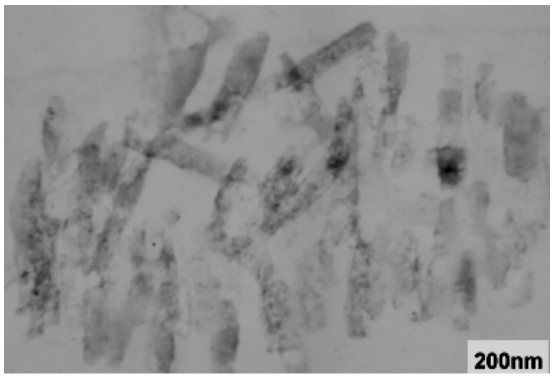

Figure S5 the TEM images of the products obtained with the condition is w = 50 and t = 24 h.

From the TEM images, we can find that the quality of the nanorods have some defects with low-grade crystallization.