Supplementary Information (SI) for CrystEngComm.

## Supporting Information

# Chemical catalytic degradation of the organic pollutant by using the Ag-$Cu_2O$ core-shell decorated on rGO

Lei Chen[1], Shuang Guo[2], Eungyeong Park[3], Hongkai Zhao[1,2,*], Young Mee Jung[2,3,*]

[1] School of Materials Science and Engineering, Jilin Jianzhu University, Changchun 130118, China.

[2] Department of Chemistry, Institute for Molecular Science and Fusion Technology, Kangwon National University, Chuncheon 24341, Korea.

[3] Kangwon Radiation Convergence Research Support Center, Kangwon National University, Chuncheon 24341, Korea.

* Correspondence: hkzhao003@126.com (H. Zhao); ymjung@kangwon.ac.kr (Y.M. Jung)

## Experimental section

### Materials

Silver nitrate ($AgNO_3$), trisodium citrate dihydrate ($Na_3C_6H_5O_7 \cdot 2H_2O$), polyvinylpyrrolidone (PVP, K30), trihydrate copper (II) nitrate ($Cu(NO_3)_2 \cdot 3H_2O$), hydrazine hydrate ($N_2H_4 \cdot H_2O$, 85%), 4-nitrophenol (4-NP), trinitrophenol (TNP) sodium borohydride ($NaBH_4$), and trichlorogold hydrochloride hydrate ($HAuCl_4 \cdot 4H_2O$) were purchased from Sinopharm Chemical Reagent Co., Ltd. All chemicals were used without further purification. Deionized water (18 MΩ·cm) was used throughout the experiments.

### Fabrication of the Ag-rGO composite

First, 2 mg of graphene oxide (GO) was dispersed in 200 mL of deionized water and sonicated for 1 hour to obtain a uniformly dispersed GO aqueous solution in a three-necked flask. Then, 36 mg of $AgNO_3$ was added to the three-necked flask and magnetically stirred at 90-92 °C until slight boiling occurred. Finally, 4 mL of 1% $Na_3C_6H_5O_7 \cdot 2H_2O$ solution was added to the three-necked flask, and the temperature was adjusted to 85 °C. The development of a dark green color in the solution indicated that the Ag-rGO composite had been obtained.

### Fabrication of ACR nanocomposites

The ACR nanocomposites were obtained by reducing $Cu(NO_3)_2 \cdot 3H_2O$ with a reducing agent in a 35% $N_2H_4 \cdot H_2O$ solution using PVP as a polymerization agent. One gram of PVP was added to 50 mL of 0.05 M $Cu(NO_3)_2 \cdot 3H_2O$ with vigorous stirring. After PVP was completely dissolved (approximately 10 min), V mL of Ag-rGO composite was added (V=0, 5, 10, and 15 mL). Then, 70 μL of $N_2H_4 \cdot H_2O$ was added to the mixed solution for 90 s under magnetic stirring (350 rpm). The obtained ACR nanocomposites with different $Cu_2O$ shells are shown in Fig. 1.

## Catalytic performance evaluation

We added 100 μL of 0.005 M 4-NP solution to 2 mL of deionized water and placed it in a quartz dish. Then, we added a freshly prepared 0.2 M $NaBH_4$ solution. The solution changed from colorless to light yellow. Afterward, different volumes of Ag-rGO composite solution were used to fabricate the ACR nanocomposites. Finally, the UV–Vis absorption spectra were measured in the range of 200-500 nm every 2 min. The catalytic performance of the core-shell structure was evaluated from the reduction rate of 4-NP. The optimized ACR nanocomposites were used as catalysts for the degradation of MO and TNP.

## Characterization

Field emission scanning electron microscopy (SEM) and transmission electron microscopy (TEM) images were obtained using a JEOL JSM-6500F (JEOL Ltd., Tokyo, Japan) and a JEOL 2100 (JEOL Ltd., Tokyo, Japan) at an acceleration voltage of 200 kV. The UV–Vis absorption spectra and catalytic properties were monitored using a SHIMADZU 3600 spectrometer (Shimadzu Corporation, Tokyo, Japan).

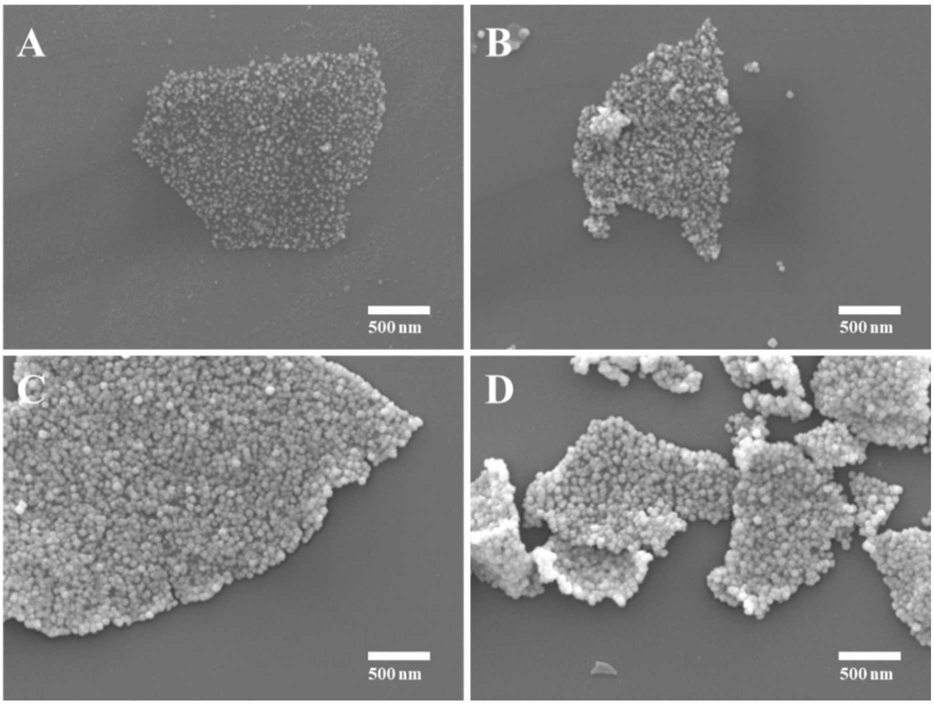

**Fig. S1.** SEM images of Ag-rGO (A) and ACRN with different thicknesses of the $Cu_2O$ shell (B-D).

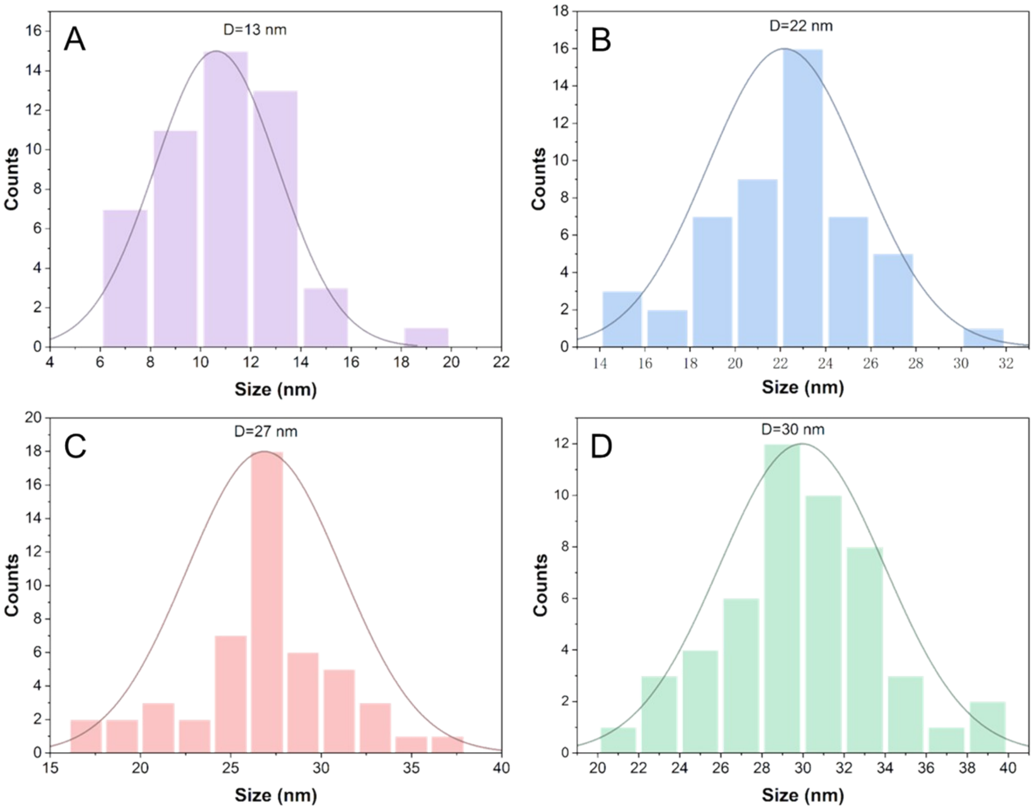

**Fig. S2.** The column charts of the average diameter of the Ag nanoparticles (A) and Ag@$Cu_2O$ which decorated on the rGO (B-D).