Electronic Supplementary Material (ESI) for Nanoscale
This journal is © The Royal Society of Chemistry 2013

Supporting Information

Silica/Titania Sandwich-like Mesoporous Nanosheets Embedded with Metal Nanoparticles Templated by Hyperbranched Poly(ether amine) (hPEA)

Bing Yu, Xuesong Jiang*, Jie Yin

School of Chemistry & Chemical Engineering, State Key Laboratory for Metal Matrix Composite Materials, Shanghai Jiao Tong University

Shanghai 200240, People's Republic of China.

Tel.: +86-21-54743268; Fax: +86-21-54747445. E-mail: ponygle@sjtu.edu.cn

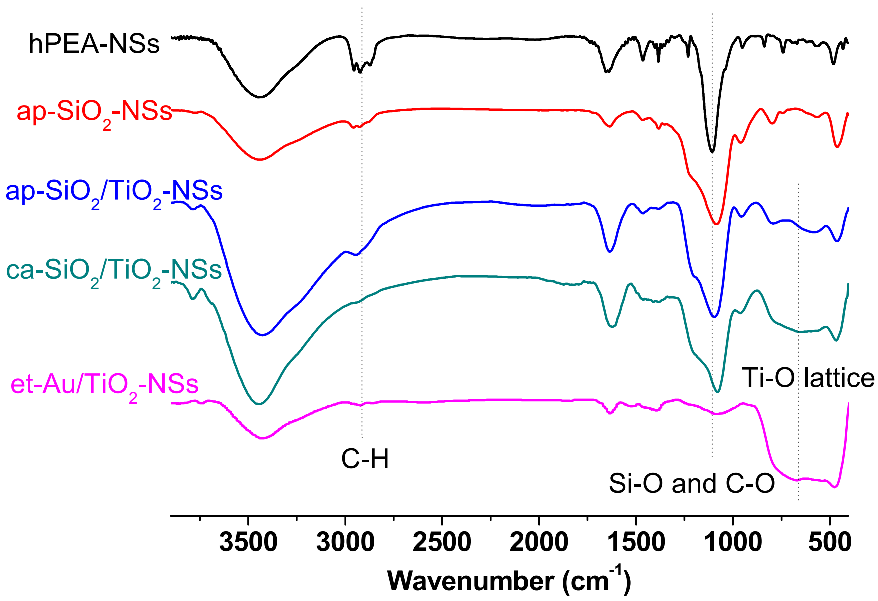

Figure S1. FT-IR spectra of hPEA-NSs, ap-SiO_2-NSs, ap-SiO_2/TiO_2-NSs, ca-SiO_2/TiO_2-NSs, and et-Au/TiO_2-NSs, respectively.

The FTIR spectra of SiO_2-NSs and SiO_2/TiO_2-NSs were also investigated (Figure S1). Compared with the template hPEA-NSs, the peak at 1098 cm^{-1} assigned to Si-O stretching vibration was obviously strengthened in the FTIR spectrum of ap-SiO_2-NSs, indicating the SiO_2 has been deposited on hPEA-NSs. Meanwhile, the very broad peak at 450-800 cm^{-1} assigned to Ti-O lattice vibration appeared, which proved TiO_2 grains had grown on the nanosheets in ap-SiO_2/TiO_2-NSs. After calcinations, the C-H stretching vibration at 2941 cm^{-1} nearly disappeared which indicated the hPEA-NSs template had been removed. The etching of the SiO_2 middle-layer was exhibited by the nearly disappearance of the Si-O stretching vibration at 1098 cm^{-1}.

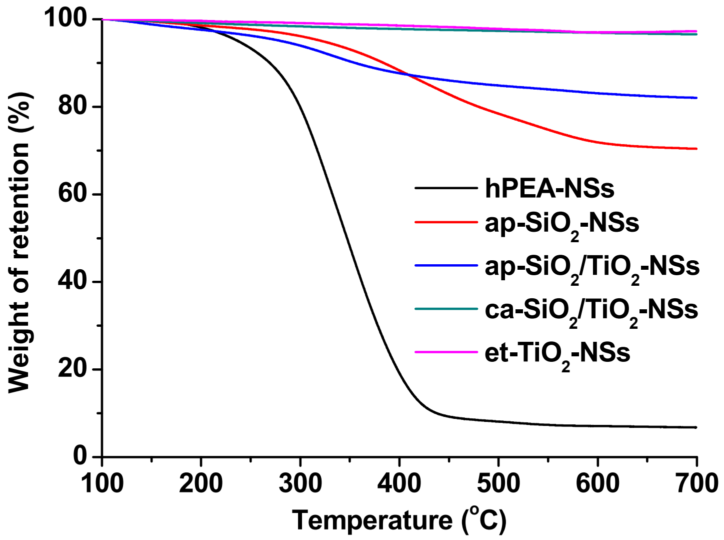

Figure S2. TGA spectra of hPEA-NSs, ap-SiO_2-NSs, ap-SiO_2/TiO_2-NSs, ca-SiO_2/TiO_2-NSs, and et-TiO_2-NSs, respectively.

As shown in Figure S2, the first weight loss below 150 ^{o}C was mostly due to water evaporation from the nanosheets, and the second weight loss occurring at 200-450 ^{o}C was attributed to the decomposition of hPEA-NSs templates. The weight of retention increased while SiO_2 and TiO_2 were deposited on hPEA-NSs, respectively, which indicated the existence of SiO_2 and TiO_2 in ap-SiO_2-NSs and ap-SiO_2/TiO_2-NSs, respectively. The samples after calcinations show only 3% weight loss at higher temperature, which implies the completely removing of the hPEA-NSs templates. The weight percentage of SiO_2 and TiO_2 can also be calculated from the TGA results.

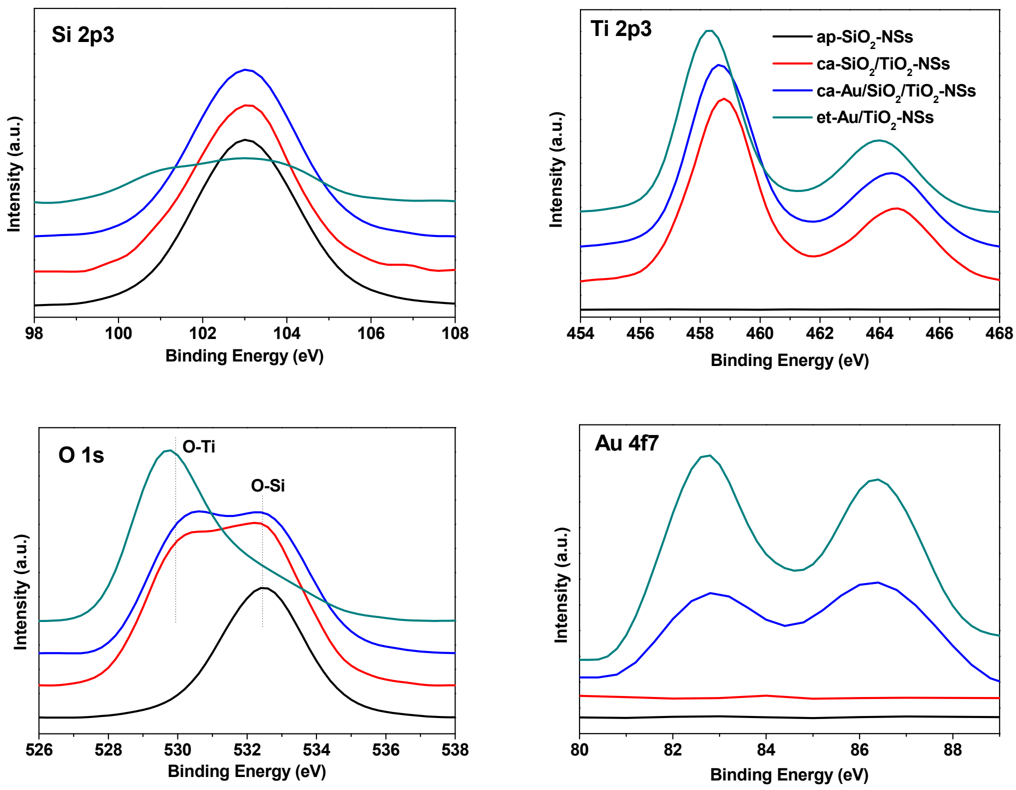

Figure S3. High-resolution XPS spectra of Si 2p3, Ti 2p3, O 1s, Au 4f7 for ap-SiO_2-NSs, ca-SiO_2/TiO_2-NSs, ca-Au/SiO_2/TiO_2-NSs, and et-Au/TiO_2-NSs, respectively.

The chemical composition of the samples was also analyzed by XPS, and the XPS spectra were shown in Figure S3. There are two peaks at the binding energies of 464.4 and 458.6 eV for Ti 2p XPS spectra of SiO_2/TiO_2-NSs, which can be assigned to Ti $2p_{1/2}$ and Ti $2p_{3/2}$, respective. This result indicates the existence of TiO_2 in these SiO_2/TiO_2-NSs. There are two peaks at the binding energies of 529.8 and 532.4 eV for O 1s in XPS spectra of SiO_2/TiO_2-NSs, which can be assigned to O 1s for TiO_2 and SiO_2, respectively. The peak for O 1s of et-Au/TiO_2-NSs at 532.4 eV was weakened compared with SiO_2/TiO_2-NSs, which indicates the successful etching of SiO_2 in Au/SiO_2/TiO_2-NSs, and this result is consistent with the weakening of the peak at the binding energy of 103.0 eV for Si 2p3 XPS spectrum of et-Au/TiO_2-NSs. Meanwhile, the binding energy of Ti $2p_{1/2}$ and Ti $2p_{3/2}$ for et-Au/TiO_2-NSs shift about 0.6 eV to the lower energy direction, and this phenomenon may be attributed to the heterostructure effect between the SiO_2 layer and TiO_2 layer in Au/SiO_2/TiO_2-NSs. Moreover, the embedding of AuNPs can be confirmed by the appearance of two peaks

This journal is © The Royal Society of Chemistry 2013

at 82.8 and 86.4 eV, which correspond to Au $4f_{5/2}$ and Au $4f_{7/2}$, respectively in XPS spectra of Au/SiO_2/TiO_2-NSs.