*Supporting Information for*

# Silica Nanosphere-Supported Shaped Pd Nanoparticles Encapsulated with Nanoporous Silica Shell: Efficient and Recyclable Nanocatalysts

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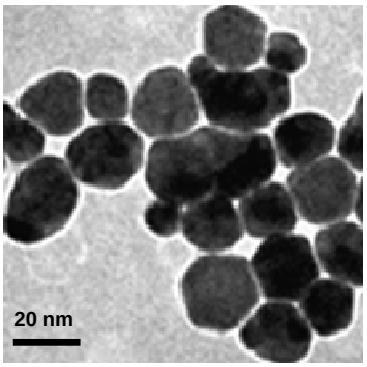
**(I)**




**(II)**

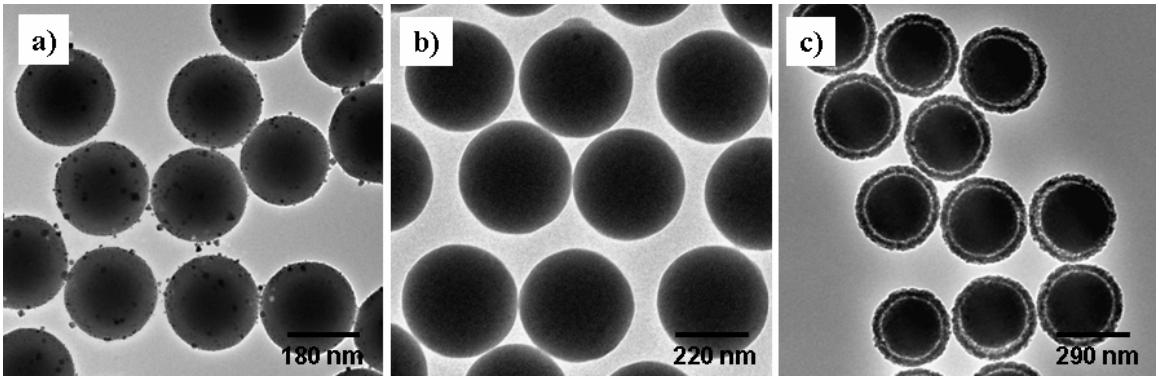



**Figure S1.** (I) TEM image of octahedral shaped Pd nanoparticles (~ 20 nm) synthesized by following the procedure reported by Lim et al. (B. Lim, Y. Xiong, Y. Xia, *Angew. Chem. Int. Ed.*, 2007, **46**, 9279). (II) Representative TEM images of (a) Pd nanoparticles (20 nm) supported on amino-modified silica nanospheres, (b) $SiO_2$/Pd-NP/$SiO_2$ core-shell-shell nanospheres, and (c) etched $SiO_2$/Pd-NP/Porous-$SiO_2$ core-shell-shell nanospheres.

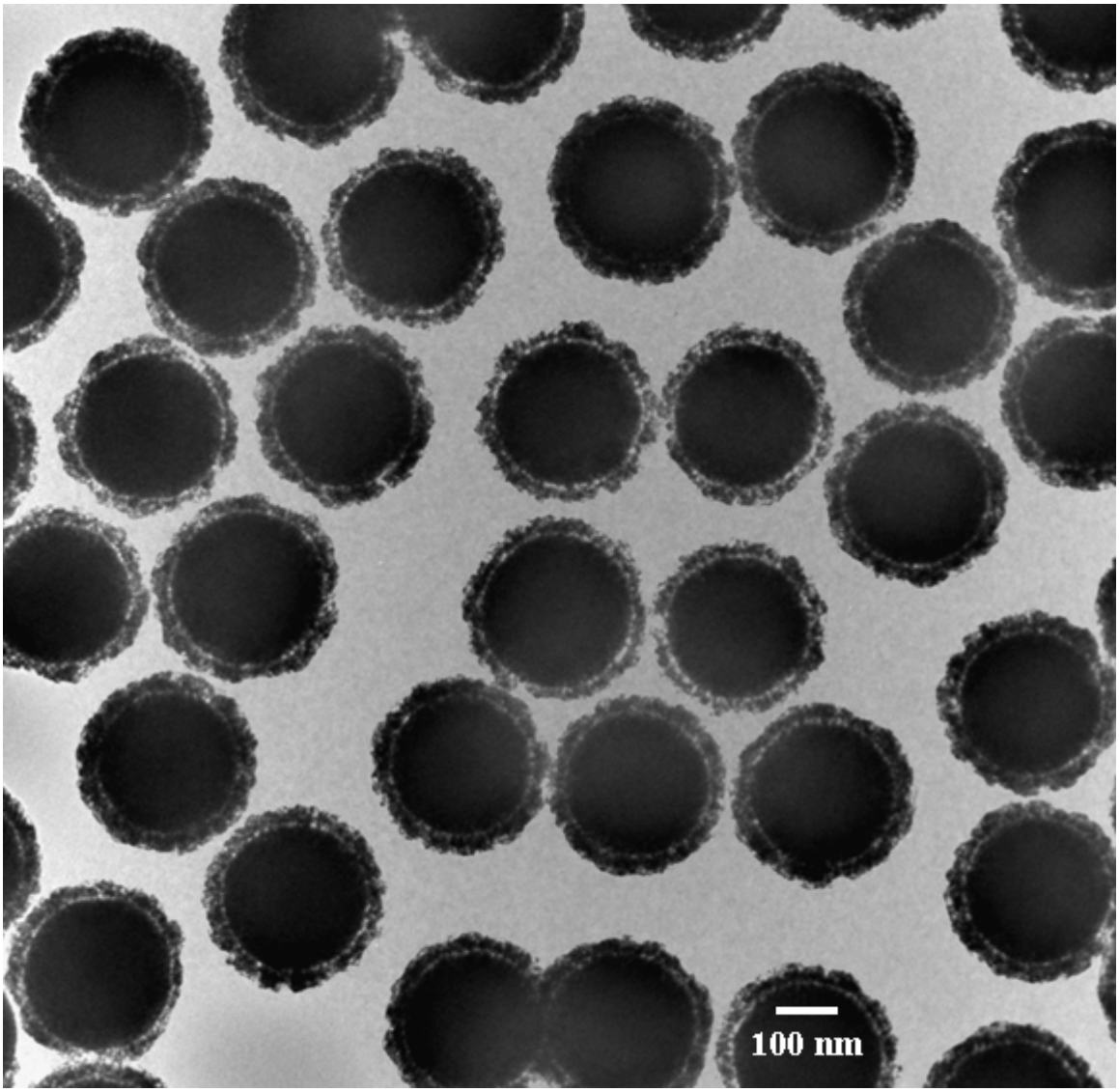



**Figure S2.** A representative TEM image of etched $SiO_2$/Pd-NP/Porous $SiO_2$ core-shell-shell nanospheres (same sample as the one in Figure 1c except that this is more magnified).

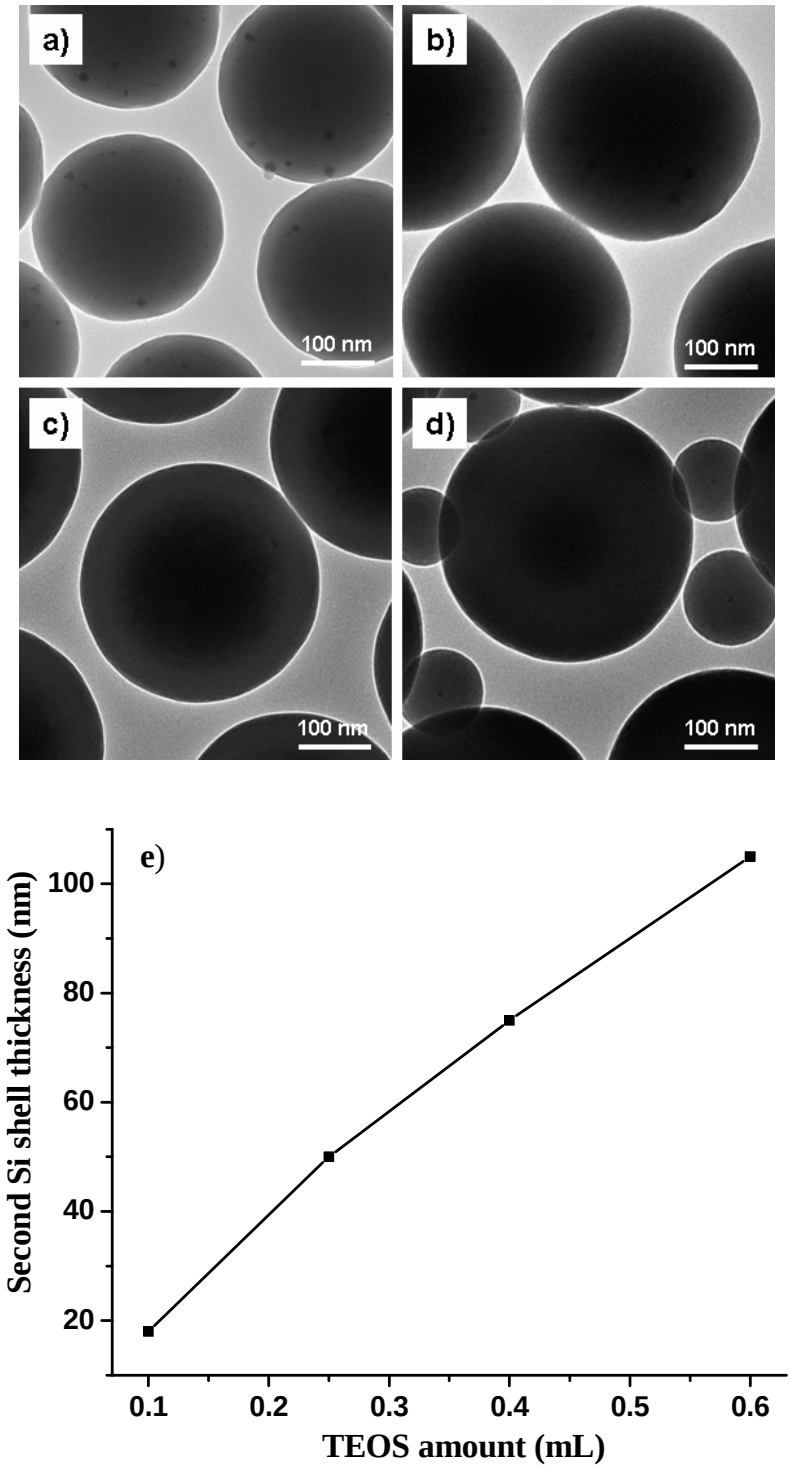



**Figure S3.** Representative TEM images of $SiO_2$/Pd-NP/$SiO_2$ core-shell-shell nanospheres possessing different thickness of silica shell made by using different amounts of TEOS: (a) 0.1 mL TEOS, (b) 0.25 mL TEOS, (c) 0.4 mL TEOS, and (d) 0.6 mL TEOS. (e) A graph showing a linear relationship between the thickness of the silica shell and the amount of TEOS used at a given $NH_4OH$ concentration and deposition time.

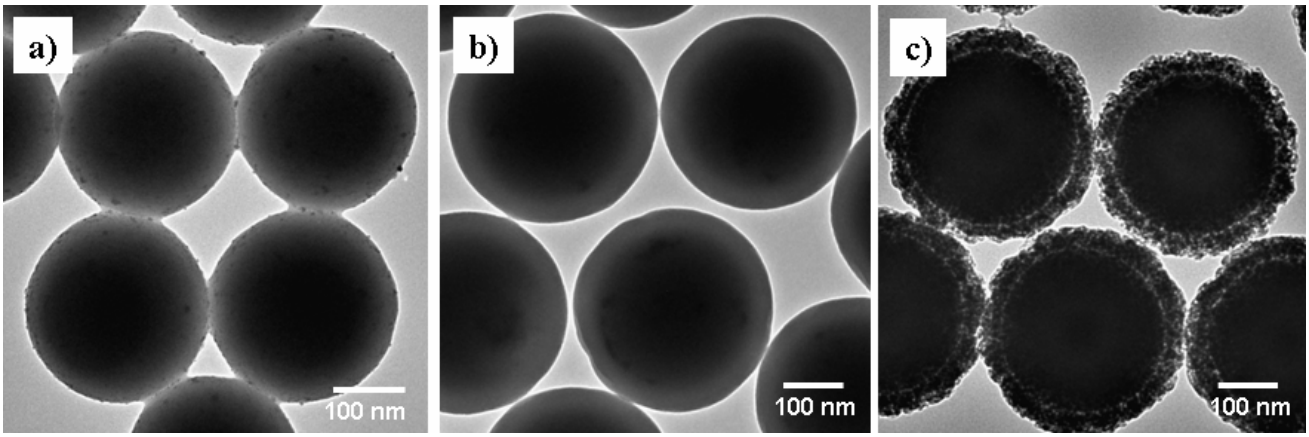



**Figure S4.** Large area TEM images of (a) Pd-NP (5 nm) supported onto amino-modified silica nanospheres, (b) $SiO_2$/Pd-NP/$SiO_2$ core-shell-shell nanospheres, and (c) etched $SiO_2$/PdNP/Porous $SiO_2$ core-shell-shell nanospheres etched for 80 min.

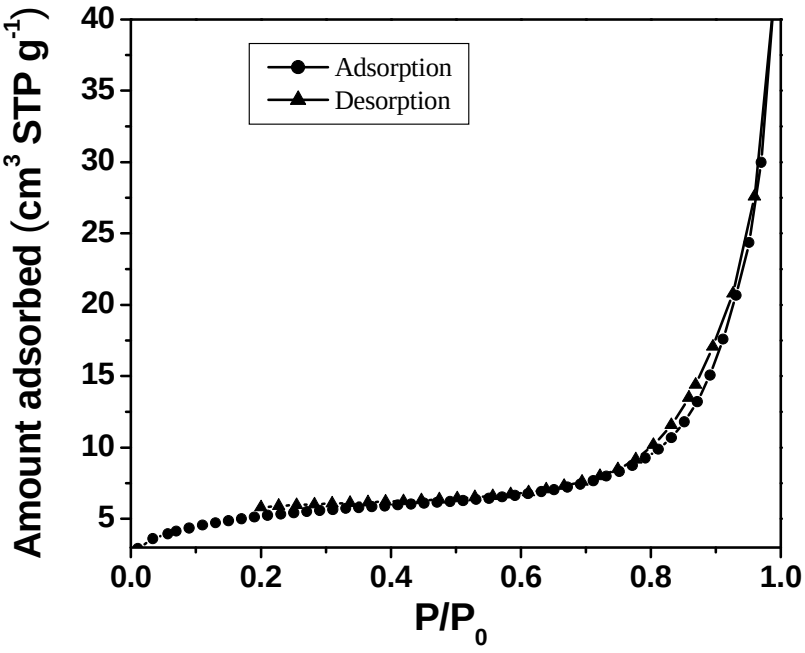



**Figure S5.** Nitrogen adsorption–desorption isotherms of $SiO_2$/Pd-NP/Porous-$SiO_2$ nanospheres that were etched for 100 min.

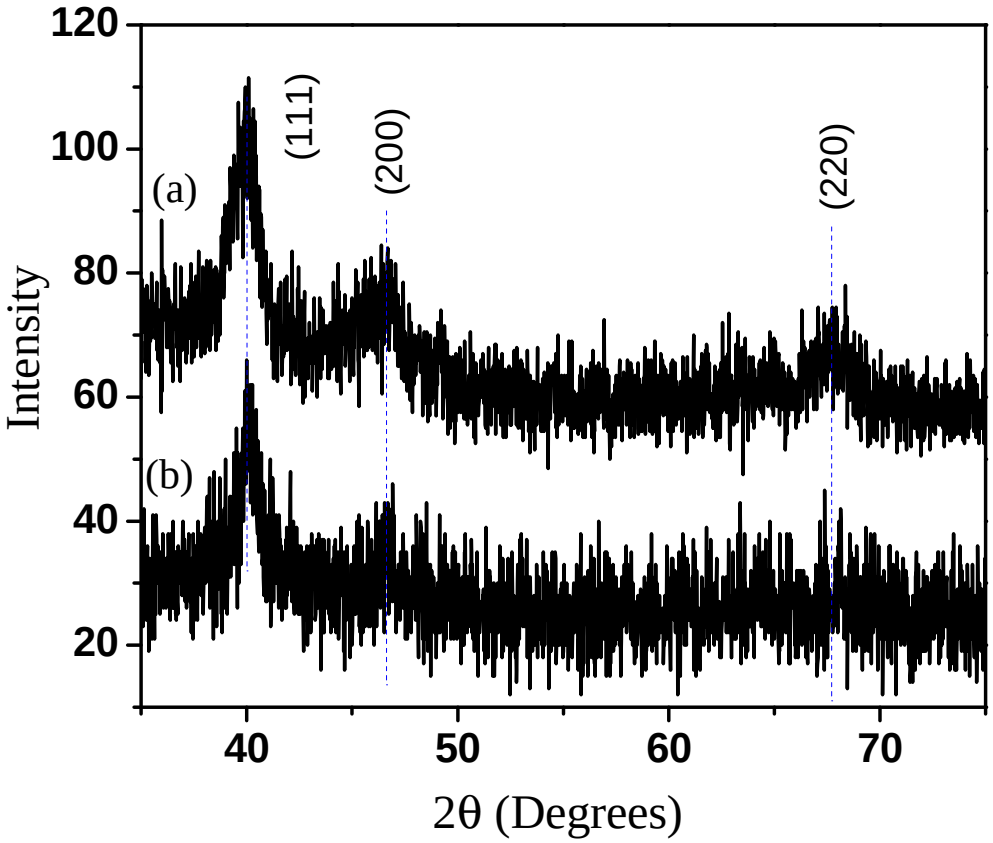



**Figure S6.** Powder XRD patterns of (a) as-prepared $SiO_2$/Pd-NP core-shell nanospheres with 5 nm Pd-NP and (b) $SiO_2$/Pd-NP/Porous-$SiO_2$ core-shell-shell nanospheres etched for 80 min with 5 nm Pd-NP.

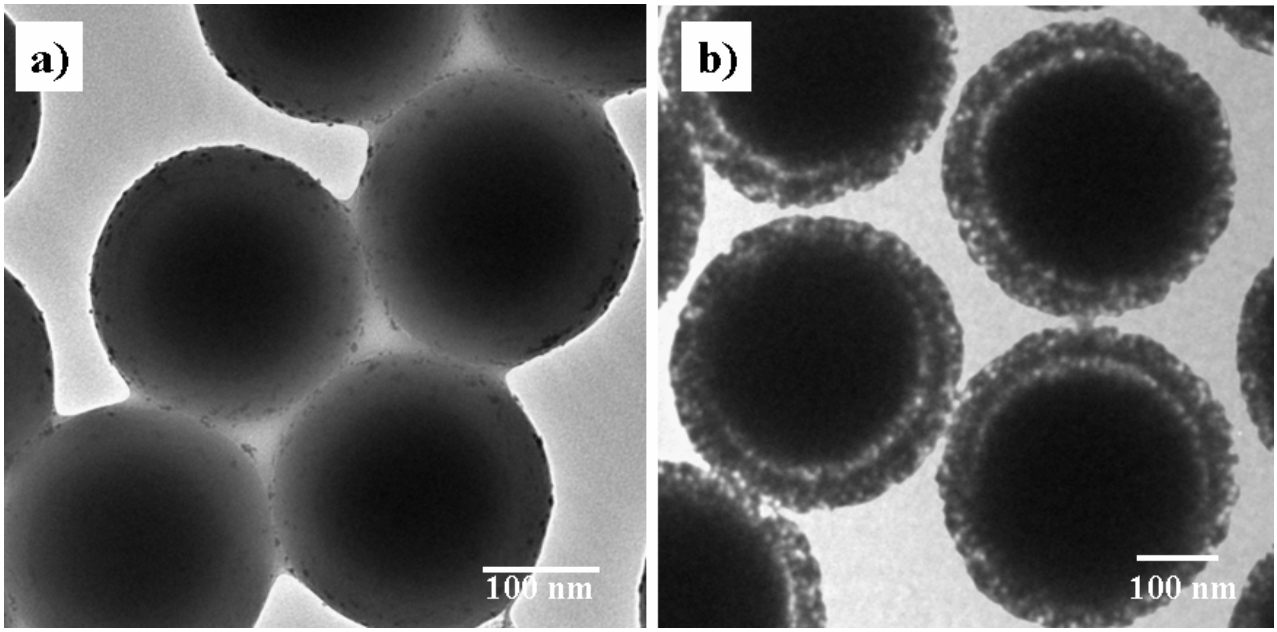



**Figure S7.** TEM images of (a) $SiO_2$/Pd-NP core-shell nanospheres and (b) $SiO_2$/Pd-NP/Porous-$SiO_2$ nanospheres after five cycles of catalysis in hydrogenation reaction.

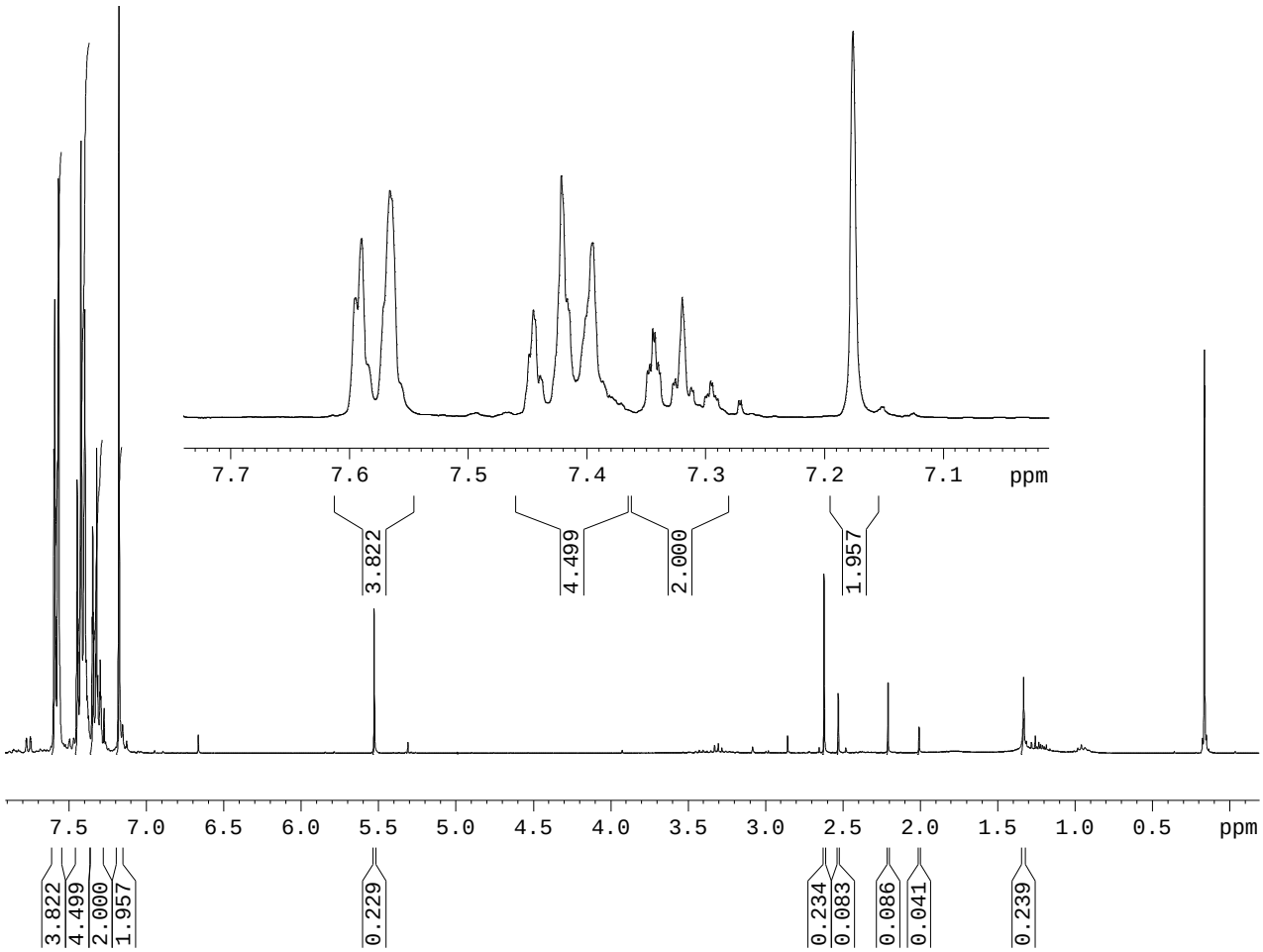



**Figure S8.** $^{1}$H NMR spectra of the Heck coupling product of trans-stilbene by using $SiO_2$/Pd-NP/Porous-$SiO_2$ nanospheres as catalyst in the Heck coupling reaction between iodobenzene and styrene. The formation of trans-stilbene was monitored by GC-MS, GC and $^{1}$H NMR. $^{1}$H NMR ($CDCl_3$, 300 MHz): δ 7.60-7.55 (m, 4H), 7.45-7.37 (m, 4H), 7.35-7.29 (m, 2H), and 7.18 (s, 2H).