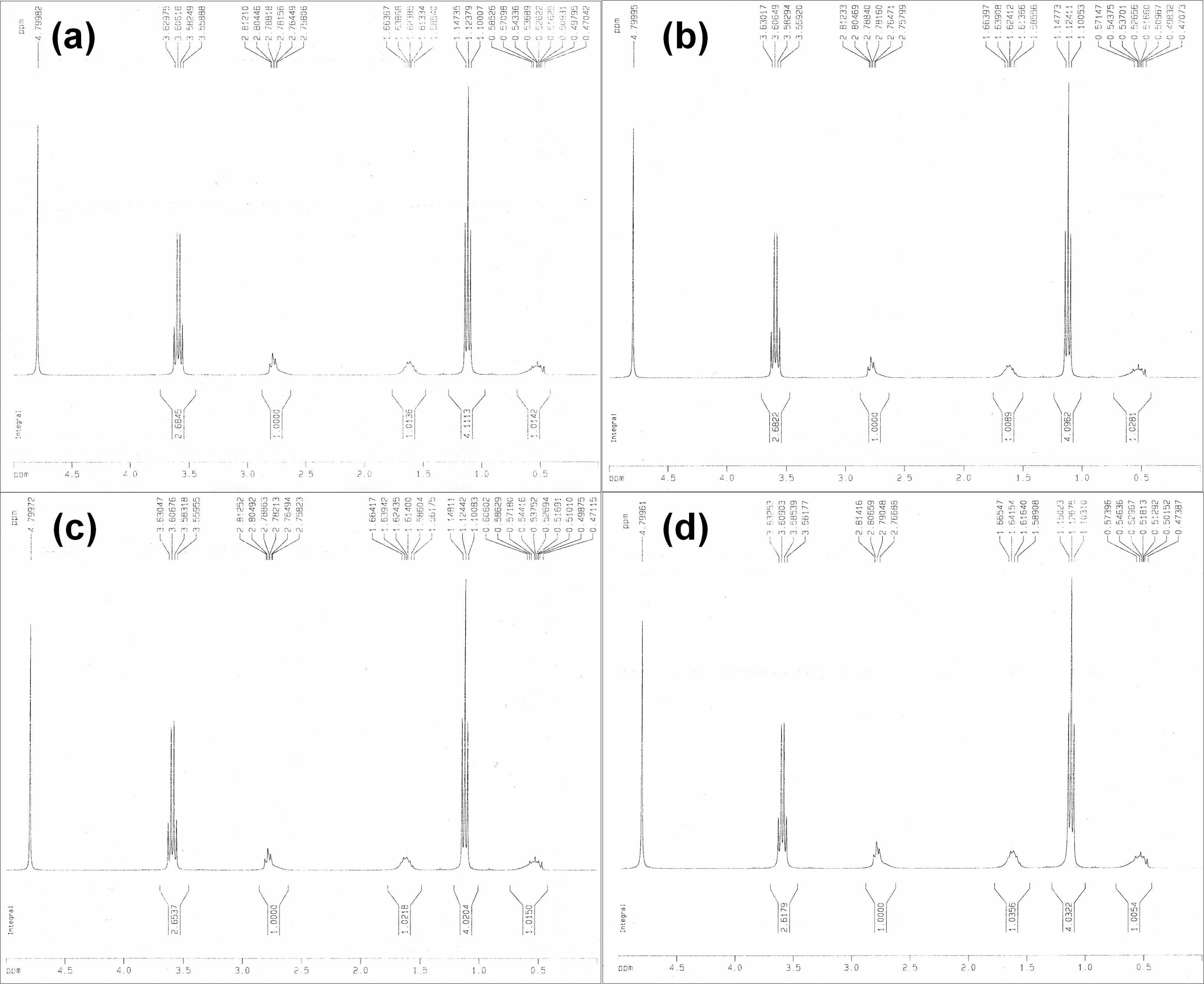
**Quantitative analysis and efficient surface modification of silica nanoparticles**

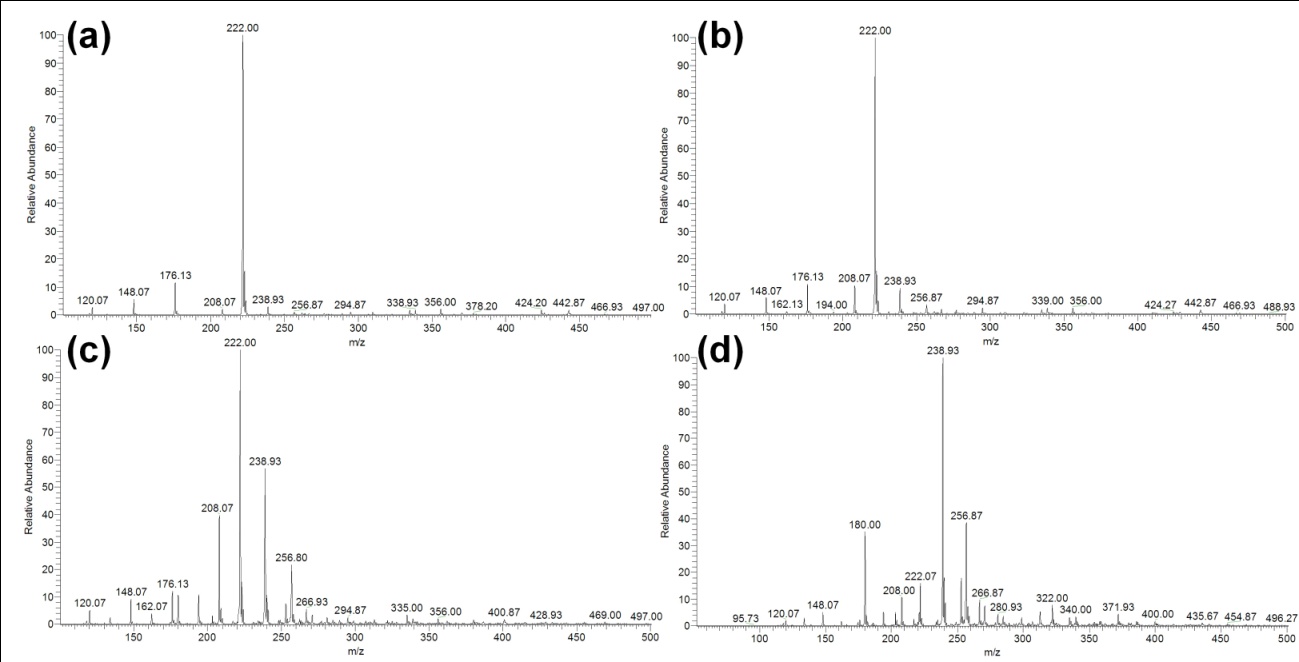
Hak Sung Jung, Doo-Sik Moon, Jin-Kyu Lee\*

*Department of Chemistry, Seoul National University, Seoul 151-747, Korea*

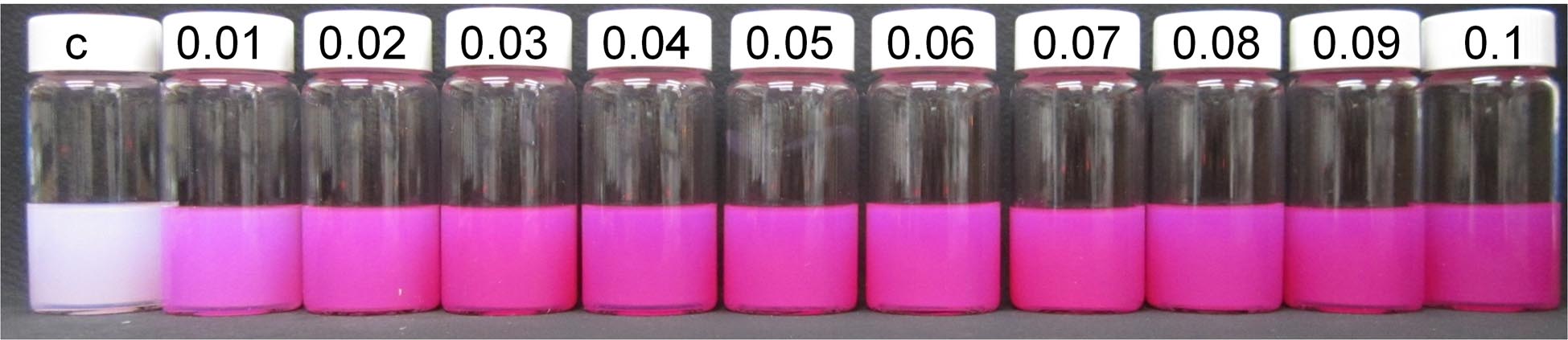
E-mail: jinklee@snu.ac.kr, Tel: +82-2-879-2923, Fax: +82-2-882-1080



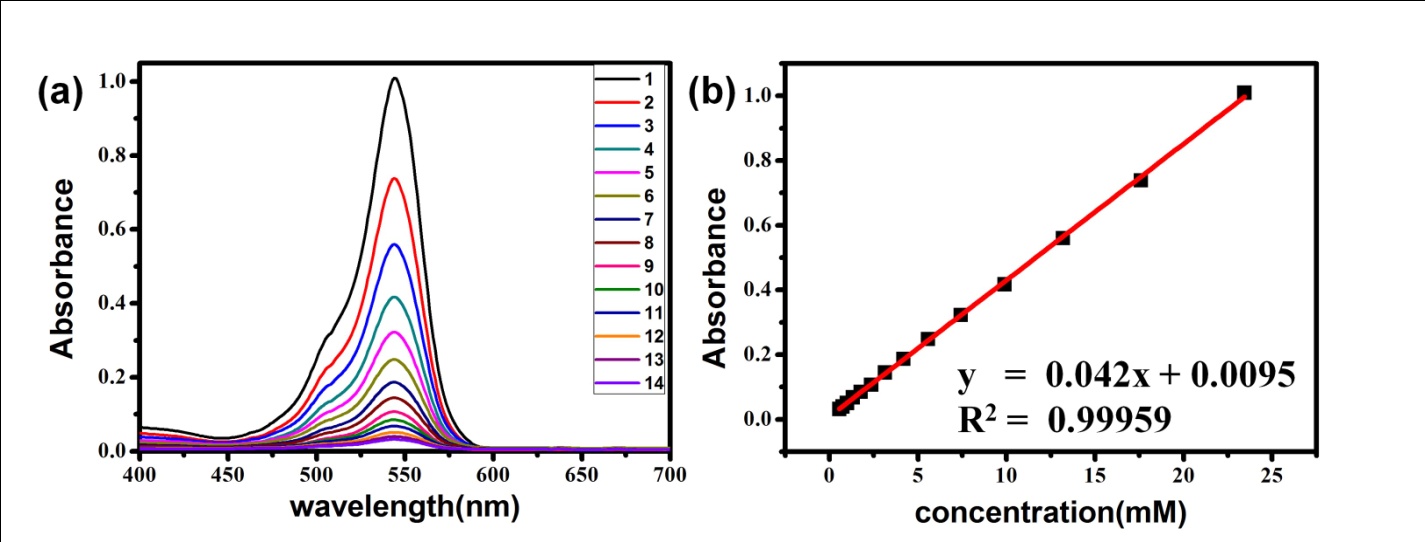
**Figure S1.** 1H-NMR spectra of APTES in D2O after (a) just mixing, (b) 30 min, (c) 1h, and (d) 4h.



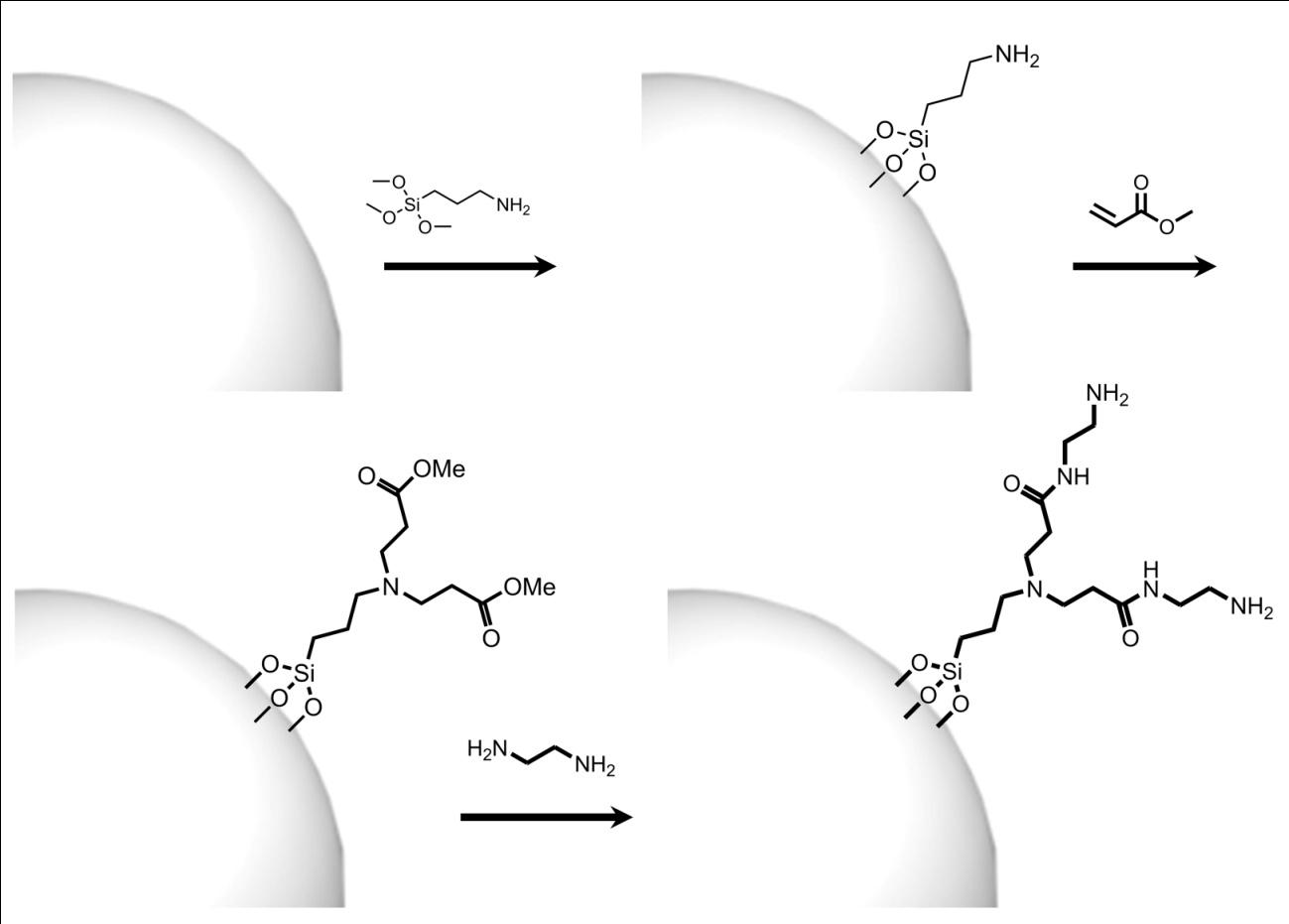
**Figure S2.** ESI-MS spectra of APTES in methanol: (a) as prepared, (b) after 30min, (c) after 3h, (d) after 6h.



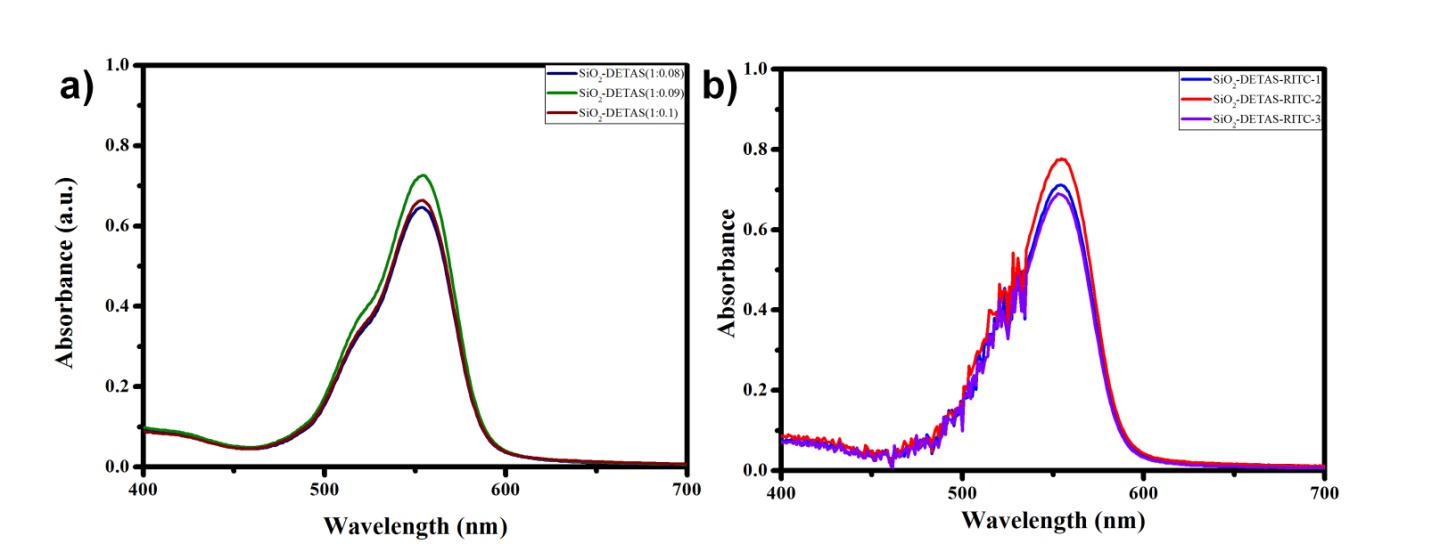
**Figure S3.** Photograph of SiO2-DETAS(RITC) nanoparticles prepared from various amounts of DETAS ligand.



**Figure S4.** (a) UV-Vis absorption spectra and (b) the calibration curve of Rhodmaine B isothiocyanate (RITC) at various concentrations



**Figure S5.** Schematic illustration of the synthesis of SiO2-EDA in a way analogous to dendrimer synthesis



**Figure S6.** The absorption spectra of a) as prepared SiO2-DETAS(RITC), b) after 1.5 month of SiO2-DETAS(RITC).

**Table S1.** Acid-base back-titration results of surface modified silica nanoparticles.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Concentration of standardized NaOH solution: 0.86 mM | | | | | | | | | | | | |
| Concentration of HCl solution for back-titration: 1.1 mM | | | | | | | | | | | | |
| Volume of HCl solution for back-titration: 10.00 mL | | | | | | | | | | | | |
| Amount of used HCl: 11 μmol | | | | | | | | | | | | |
|  | Volume of NaOH solution (mL) |  | | | Amount of NaOH (μmol) | | |  | | Amount of HCl reacted with surface amine sites (μmol) | | |
| SiO2-APTMS-1 | 11.25 |  | | | 9.7 | | |  | | 1.3 | | |
| SiO2-APTMS-2 | 11.75 |  | | | 10 | | |  | | 1 | | |
| SiO2-APTMS-3 | 11.40 |  | | | 9.8 | | |  | | 1.2 | | |
|  |  |  | | |  | | |  | |  | | |
| SiO2-EDA-1 | 9.95 |  | | | 8.6 | | |  | | 2.4 | | |
| SiO2-EDA-2 | 10.55 |  | | | 8.1 | | |  | | 2.9 | | |
| SiO2-EDA-3 | 8.75 |  | | | 7.5 | | |  | | 3.5 | | |
| Concentration of standardized NaOH solution: 3.6 mM | | | | | | | | | | | | |
| Concentration of HCl solution for back-titration: 1.2 mM | | | | | | | | | | | | |
| Volume of HCl solution for back-titration: 10.00 mL | | | | | | | | | | | | |
| Amount of used HCl: 12 μmol | | | | | | | | | | | | |
|  | Volume of NaOH solution (mL) | |  | | | Amount of NaOH (μmol) | | |  | Amount of HCl reacted with surface amine sites (μmol) | | |
| SiO2-DETAS-1 | 2.45 | |  | | | 8.75 | | |  | 3.25 | | |
| SiO2-DETAS-2 | 2.45 | |  | | | 8.75 | | |  | 3.25 | | |
| SiO2-DETAS-3 | 2.40 | |  | | | 8.57 | | |  | 3.43 | | |
| Calculated weight of a single SiO2 NP from the bulk density | | | | | | | 1.2ⅹ10-12 mg/ea | | | | | |
| Used amount of SiO2 NP | | | | | | | 10 mg | | | | | |
| Numbers of SiO2 NPs in 10 mg sample | | | | | | | 8.3ⅹ1012 ea | | | | | |
| Surface area of a single SiO2 NP | | | | | | | 31000 nm2 | | | | | |
| Total surface area of 10 mg SiO2 NPs sample | | | | | | | 2.6ⅹ1017 ea·nm2 | | | | | |
|  | **Number of amine (ea)** | | |  | | **ea/nm2** | | |  | | **Average value (ea/nm2)** | |
| SiO2-APTMS-1 | 7.8ⅹ1017 | | | 3.0 | | |  | |  |  |
| SiO2-APTMS-2 | 6.0ⅹ1017 | | | 2.3 | | |  | | 2.7±0.29 |  |
| SiO2-APTMS-3 | 7.3ⅹ1017 | | | 2.8 | | |  | |  |  |
|  |  | | |  | | |  | |  |  |
| SiO2-EDA-1 | 1.4ⅹ1018 | | |  | | 5.6 | | |  | |  |  |
| SiO2-EDA-2 | 1.1ⅹ1018 | | | 6.7 | | |  | | 6.8±1.1 |  |
| SiO2-EDA-3 | 2.1ⅹ1018 | | | 8.2 | | |  | |  |  |
|  | | | | | | | | | | | | |
| SiO2-DETAS-1 | 2.0ⅹ1018 | | |  | | 7.6 | | |  | |  |  |
| SiO2-DETAS-2 | 2.0ⅹ1018 | | | 7.6 | | |  | | 7.7±0.19 |  |
| SiO2-DETAS-3 | 2.1ⅹ1018 | | | 8.0 | | |  | |  |  |