Electronic supplementary material (ESI)

A Facile Cost-effective Electrolyte-assisted Approach and Comparative study towards the Greener Synthesis of Silica Nanoparticles

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Experimental section

Synthesis

SiNP has been synthesized in different solvent with different amounts of electrolyte and finally able to optimize the amounts of electrolyte, which can produce particle in nm sized with low polydispersity. All the synthesis was repeated and we found that all the particles are highly reproducible by sizes and PDI Values.

Table S1: Optimization of electrolyte concentration in different solvent.

Solvent Conc.	Electrolyte conc.	Zeta potential value	Average hydrodynamic size (nm)
30% ethanol	0.080M	-30.2mV	>1µm
30% ethanol	0.075M	-31.2mV	800nm
30% ethanol	0.068M	-31.6mV	307nm
30% methanol	0.068M	-29.8mV	270nm
30% isopropanol	0.068M	-33.8mV	>1µm
30% isopropanol	0.034M	-38.7mV	>1µm
30% isopropanol	0.014M	-60.1mV	481nm

40%Ethanol	0.068M	-31.8mV	>1µm
40%Ethanol	0.034M	-39mV	309nm

Molybdate assay

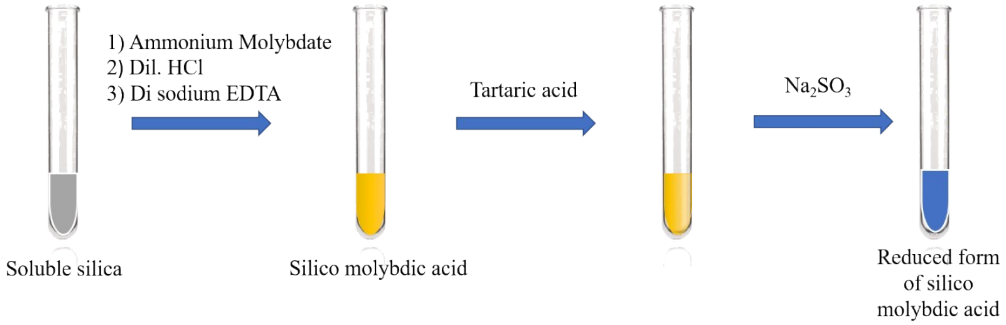

Fig. S1: Schematic presentation of soluble silica to blue colored silico molybdate formation.

H_8SiO_6, this form of silicic acid is soluble in water which upon reaction with ammonium molybdate $[(NH_4)_2MoO_4]$ gives yellow solution of silico molybdic acid $H_8[Si\ (Mo_2O_7)_6]$, and finally reduced to blue color by the reduction of sodium sulfite.

$$\mathbf{H_8SiO_6 + 12(NH_4)_2MoO_4 + 12H_2SO_4 \rightarrow H_8[Si\ (Mo_2O_7)_6] + 12(NH_4)2SO_4 + 12\ H_2O}$$

Now, this blue solution was used to measure the absorbance at 690-700 nm. From this absorbance data the concentration of silicic acid was measured.

Calculation of change in relative concentration of silica nanoparticle ($\frac{C}{C_0}$)

$$A = \varepsilon C l$$

A= absorbance ε = molar absorptivity **C**= concentration **l** = path length

Using this absorbance, the C/C_0 value was calculated.

$$\frac{C}{C_0} = \frac{C_0 - C_t}{C_0}$$

$$\frac{C}{C_0} = \frac{\left(\frac{A_0 - A_t}{\varepsilon l}\right)}{\frac{A_0}{\varepsilon l}}$$

$$\frac{C}{C_0} = \frac{A_0 - A_t}{A_0}$$

C = (Conc. Of initial silicic acid - Conc. Of silicic acid in specific time) = nanoparticle concentration. Co = Conc. Of initial silicic acid.

A_0 = Absorbance of initial silicic acid. A_t = Absorbance of silicic acid in specific time interval.

Adsorption study of MB dye by SiNP

Four different concentrations (5mg/L, 4mg/L, 3mg/L, 2mgL) of 10mL Methylene Blue (MB) dye solution was used for adsorption of MB dye on 10 mg SiNP. The OD of all the solution was checked by using UV-vis spectrophotometer in specific time interval for 2hr to know the C_0 i.e., Initial conc. of adsorbate (MB Dye). Finally, we calculate the Q_e (amount of adsorbed adsorbate (MB Dye) at equilibrium) by using the below equation,

$$\frac{C_0}{C_e} = \frac{A_0}{A_e}$$

$$C_e = \frac{A_e}{A_0} C_0$$

$$Q_e = \frac{(C_0 - C_e)}{M} V$$

A_0 = initial absorbance A_e= final absorbance

C_e = Conc. of adsorbate at equilibrium (MB Dye) C_0 = Initial conc. of adsorbate (MB Dye)

Q_e = amount of adsorbed adsorbate (MB Dye) at equilibrium

M= Mass of nanoparticle in g

V = Volume of solution in L.

Calculation of SiNP Specific Surface Area

<u>Equation of Langmuir isotherm for the adsorption.</u>

$$Q_e = \frac{Q_m C_e}{k_d + C_e}$$

$$\frac{1}{Q_e} = \frac{k_d}{Q_m C_e} + \frac{1}{Q_m}$$

$$\frac{1}{Q_m} = intercept = 0.4$$

Q_m = 2.5mg/5mg= 0.5g/g = 0.001563mol/g

Specific surface area

$$S_L = Q_m \delta N$$

S_L = 0.001563 x 175 x 10^{-20} x 6.023 x 10^{23} = 1647.68 m^2/g.

$$\delta = area\ occupied\ by\ MB\ dye = 175\ Å^2$$

N = Avogadro number

Q_m = maximum adsorption capacity

Table S2: Max Absorption capacity (Q_m) and specific surface area (S_L)

R^2	Q_m (mmol/g)	S_L (m^2/g)
0.988	1.563	1647.68

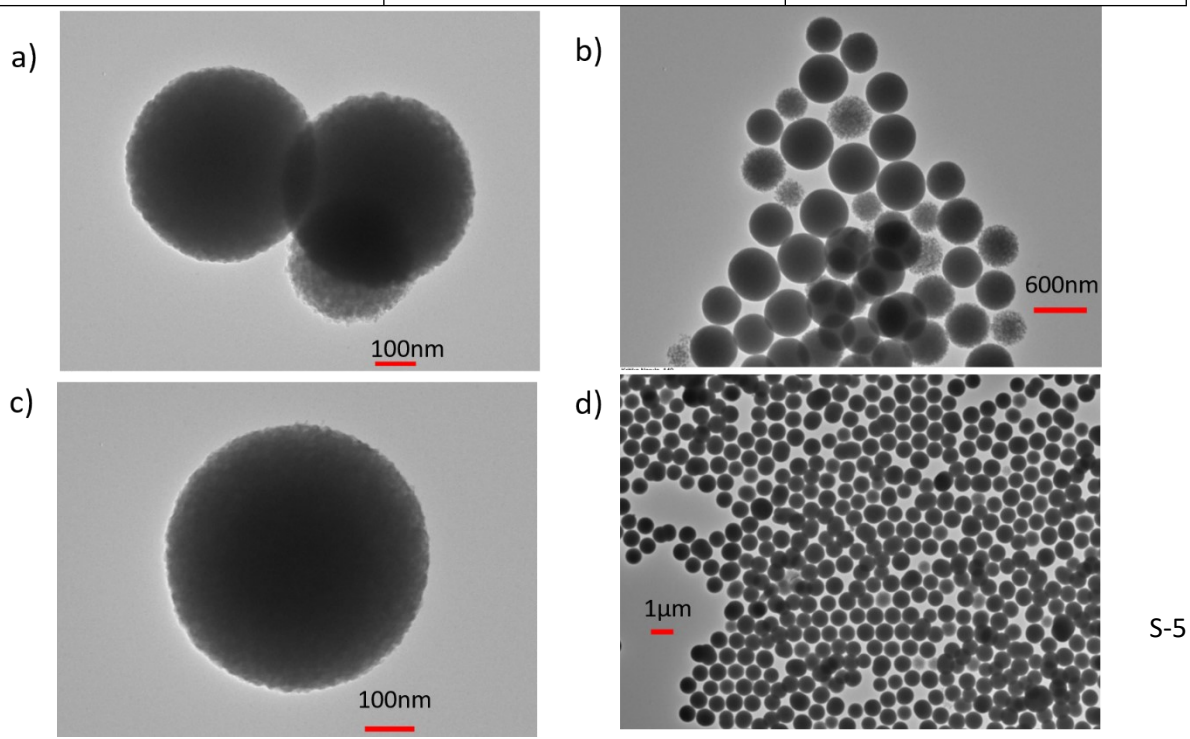

Fig. S2: a) & b) TEM images of SiNP synthesized using only 60% alcohol. c) & d) TEM images of SiNP synthesized using 30% alcohol in presence of electrolyte. The figures clearly indicate the presence of homogeneous particles supported by the PDI values as found in hydrodynamic size measurements

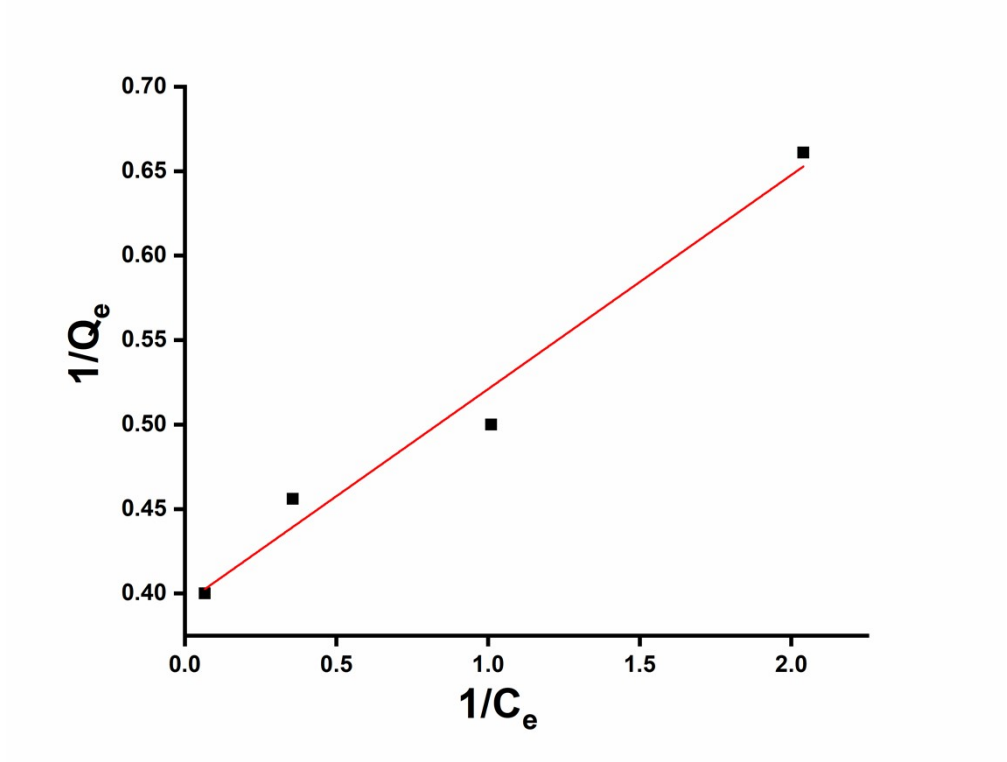

Fig. S3: Langmuir Adsorption Isotherm for monolayer adsorption on silica nanoparticles

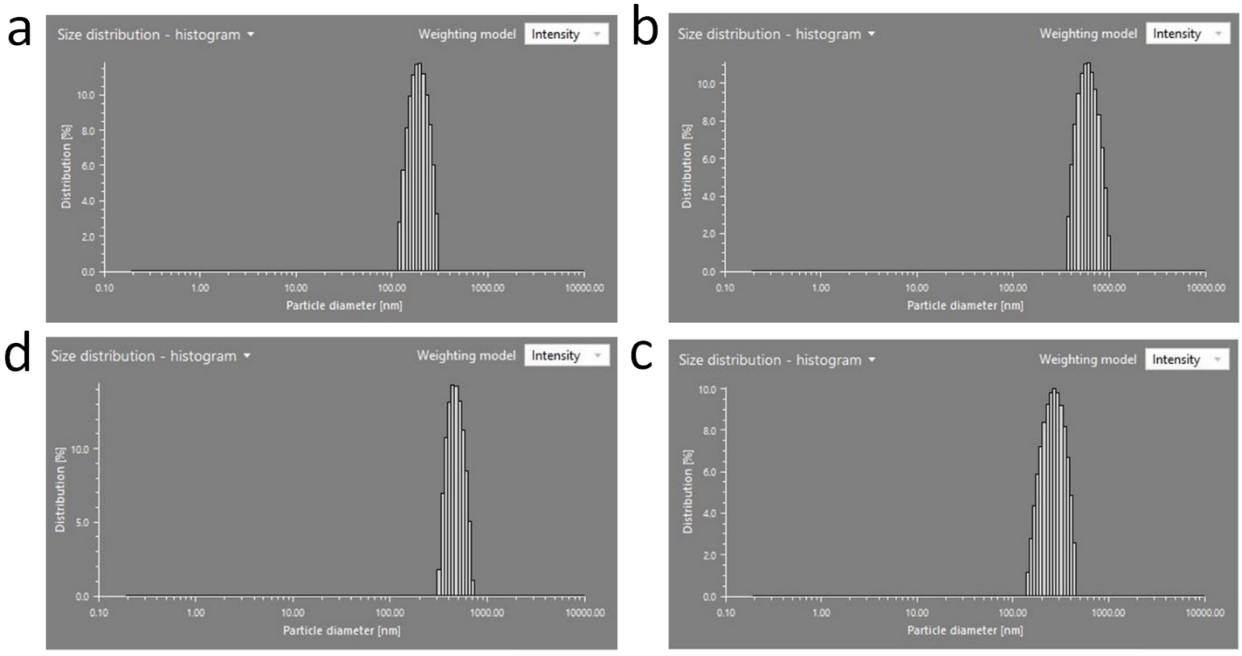

Fig. S4: Particle size distribution of silica nanoparticles synthesized under different conditions.