Electronic Supplementary Material (ESI) for Nanoscale.

Supporting information

Solution Phase Synthesis of Two-Dimensional Silica Nanosheets using Soft Template and their Applications in CO_2 Capture

Baljeet Singh and Vivek Polshettiwar*

Department of Chemical Sciences, Tata Institute of Fundamental Research (TIFR), Mumbai, India. Email: vivekpol@tifr.res.in

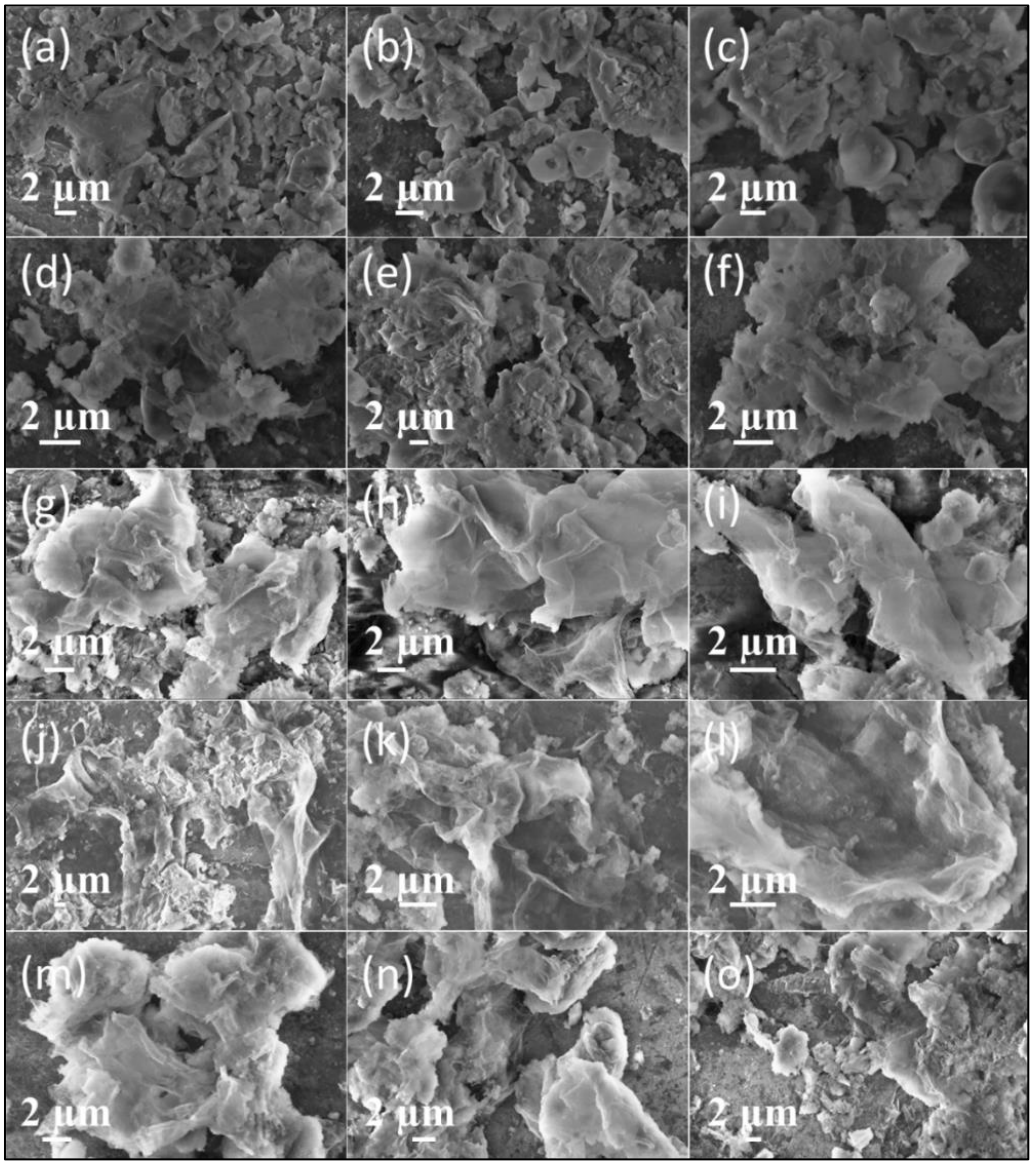

Figure S1. SEM of silica nanosheets at different reaction time's interval at 120 °C, (a, b, c) SNS-1 (0 minutes); (d, e, f) SNS -2 (10 minutes); (g, h, i) SNS -3 (30 minutes); (j, k, l) SNS -4 (1 h); (m, n, o) SNS -5 (4 h).

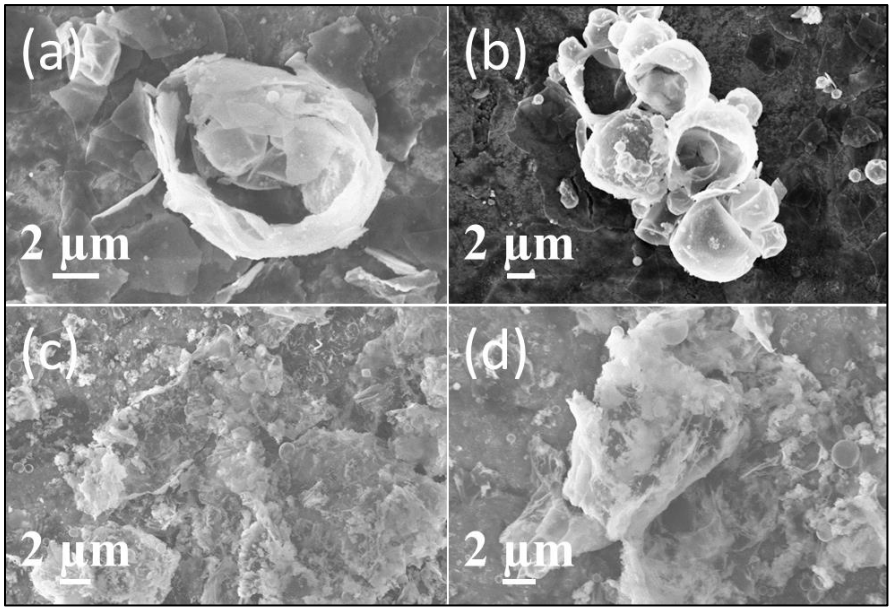

Figure S2. SEM images of materials formed in control experiments (a, b) without 1-pentanol; (c, d) without CTAB.

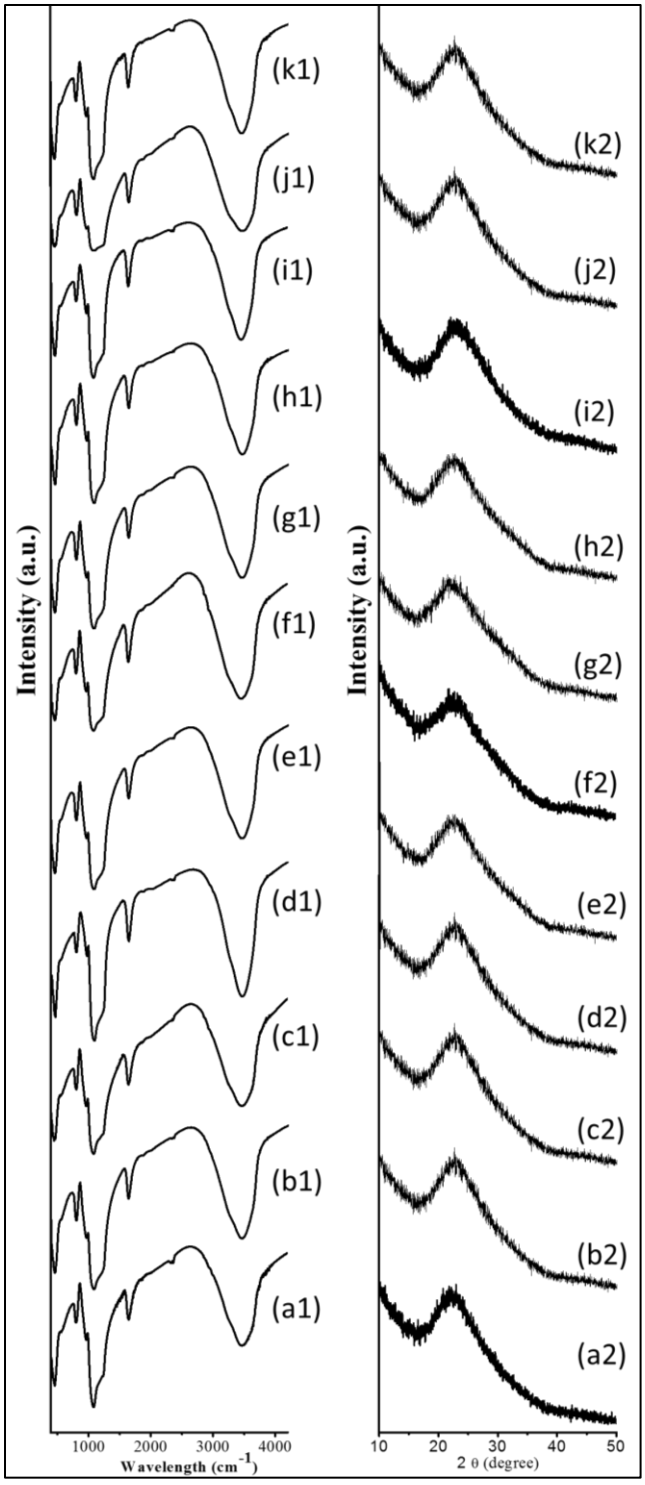

Figure S3. FTIR and PXRD spectra's of silica nanosheets, (a1, a2) SNS -1; (b1, b2) SNS -2; (c1, c2) SNS -3; (d1, d2) SNS -4; (e1, e2) SNS -5; (f1, f2) SNS -6; (g1, g2) SNS -7; (h1, h2) SNS -8; (i1, i2) SNS -9; (j1, j2) SNS -10; (k1, k2) SNS -11.

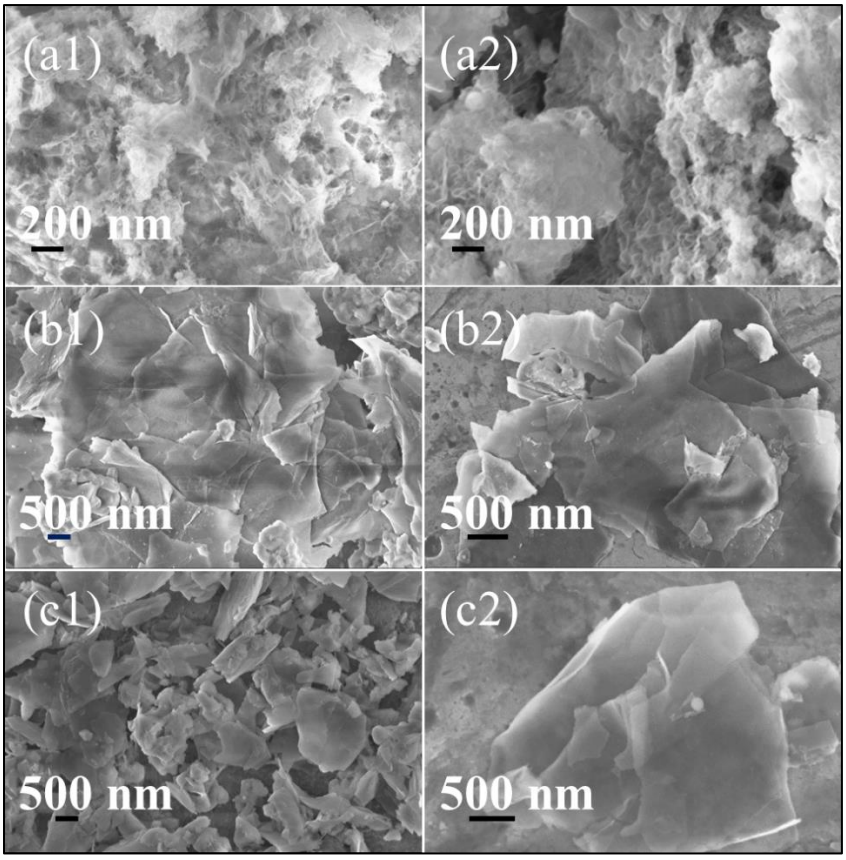

Figure S4. SEM images of silica nanosheets after TEPA loading (a1, a2) SNS -10-TEPA$_{ads}$ (b1, b2) SNS -12-TEPA$_{ads}$ (c1, c2) SNS -16-TEPA$_{ads}$.

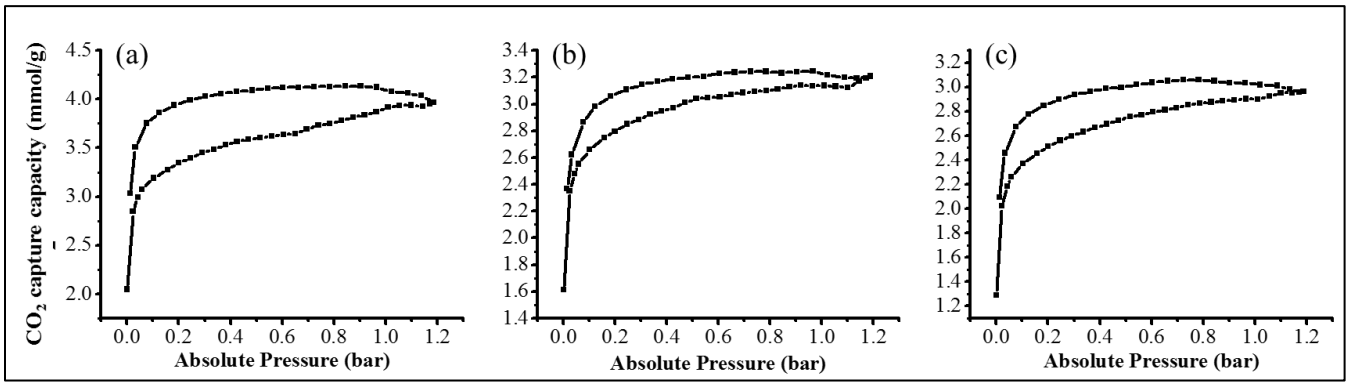

Figure S5. Volumetric CO_2 capture capacity at 75 ºC using 100 % CO_2 (a) SNS -10-TEPA$_{ads}$ (b) SNS -12-TEPA$_{ads}$ (c) SNS -16-TEPA$_{ads}$.

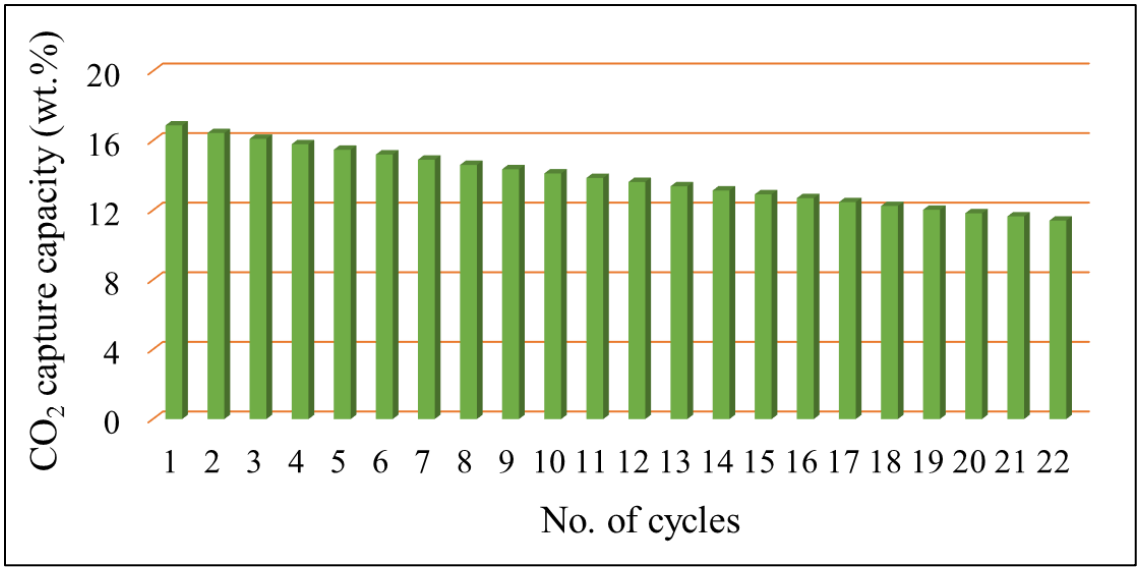

Figure S6. Recyclability of SNS -10-$TEPA_{ads}$ at 75 ºC using 15 % CO_2 in N_2.

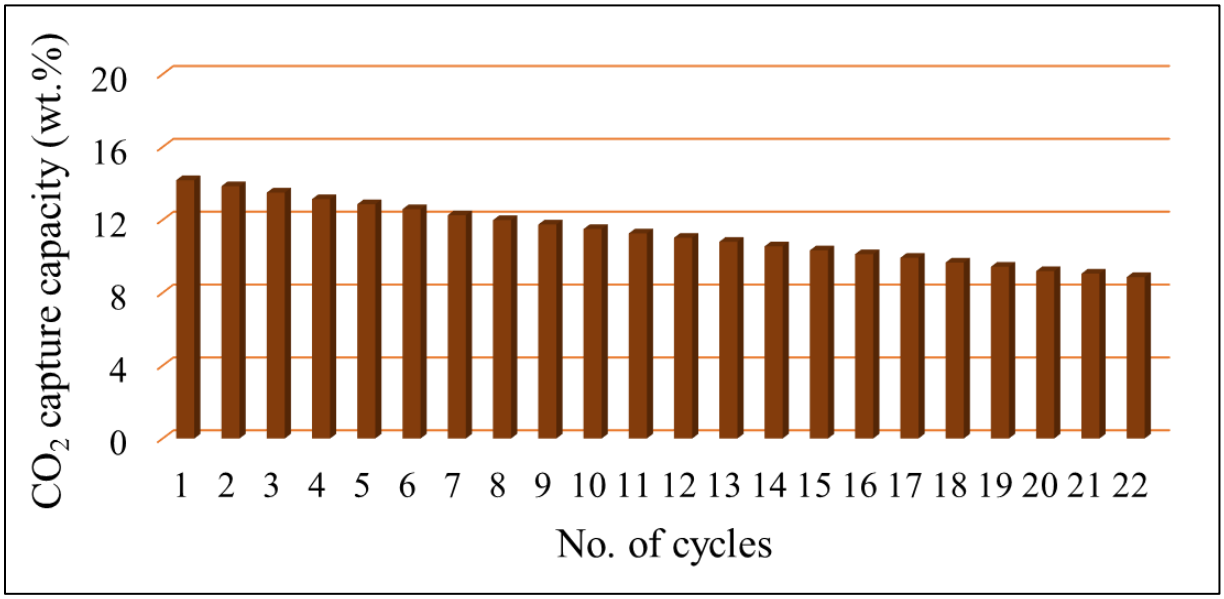

Figure S7. Recyclability of SNS -12-$TEPA_{ads}$ at 75 ºC using 15 % CO_2 in N_2.

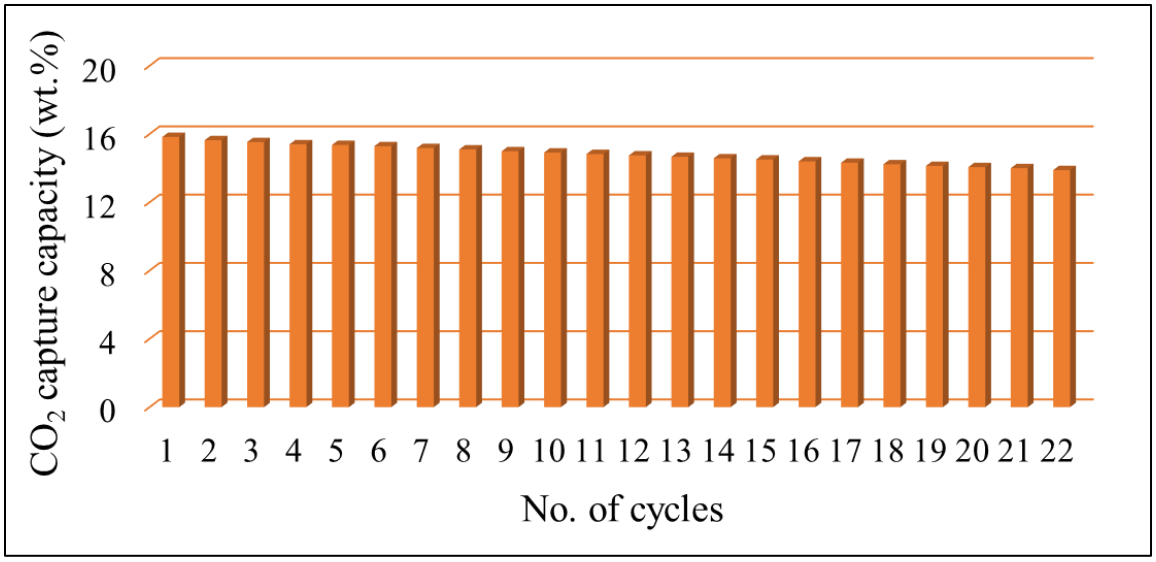

Figure S8. Recyclability of SNS -16-TEPA$_{ads}$ at 75 ºC using 15 % CO_2 in N_2.

Table S1. CO_2 capture performance of sorbents at 75 °C using 15% CO_2.

Sorbents	**BET Surface Area (m^2/g)**	**Pore Volume (cm^3/g)**	**Nitrogen Contents (mmol/g)**	**CO_2 capture capacity (mmol/g)**	**Amine Efficiency**
SNS-10-TEPA$_{ads}$	280±15	0.25±0.06	12.9±0.4	3.8±0.10	0.29
SNS-10-LMW-PEI$_{ads}$	120±5	0.44±0.05	12.5±1.2	2.2±0.10	0.17
SNS-10-APTS	280±15	0.81±0.08	4±0.04	0.6±0.02	0.14

Table S2. CO_2 capture performance of sorbents at 75 °C using 15% CO_2.

Sample Name	**BET Surface area (m^2/g)**		**Pore volume (cm^3/g)**		**Nitrogen contents (mmol/g)**	**Volumetric CO_2 capture capacity at 75ºC (mmol/g)**	**Gravimetric CO_2 capture capacity mmol/g (mmol/g)**	**Amine efficiency**
	Before	**After**	**Before**	**After**				
SNS-10-TEPA$_{ads}$	1420 ±60	280± 15	2.76±0.02	0.25± 0.01	14.2	4	3.8	0.26
SNS-12-TEPA$_{ads}$	1140 ±45	350± 17	1.05±0.01	0.46± 0.01	15	3.2	3.2	0.21
SNS-16-TEPA$_{ads}$	1120 ±45	340± 14	1.94±0.01	0.75± 0.01	14.2	3	3.6	0.25

Amine efficiency= mmol of CO_2 / mmol of N. Standard error in Nitrogen contents ±0.001 mmol, CO_2 capture ±1 wt.%.

Table S3. Textural properties and amine loading of sorbent after 22 cycles of CO_2 adsorption-desorption cycles at 75 ºC using 15% CO_2

Sample Name	**BET Surface area (m^2/g)**		**Pore volume (cm^3/g)**		**Nitrogen contents (mmol/g)**		**Amine loss in 22 cycles in mmol/g (percentage)**
	Before 22 cycles	**After 22 cycles**	**Before 22 cycles**	**After 22 cycles**	Before 22 cycles	After 22 cycles	
SNS-10-$TEPA_{ads}$	280±15	550±22	0.25±0.01	0.60±0.01	14.2	11.8	2.4 (16.9 %)
SNS-12-$TEPA_{ads}$	350±17	740±30	0.46±0.01	0.79±0.01	15	12.9	2.1 (14.0 %)
SNS-16-$TEPA_{ads}$	340±14	510±20	0.75±0.01	0.86±0.01	14.2	13.4	0.8 (5.5 %)