InterPore JOURNAL

Supplementary Material

3D PRINTING REACTIVE POROUS MEDIA: CALCITE PRECIPITATION KINETICS ON SURFACE FUNCTIONALIZED POLYMER FILMS AND 3D-PRINTED CORES

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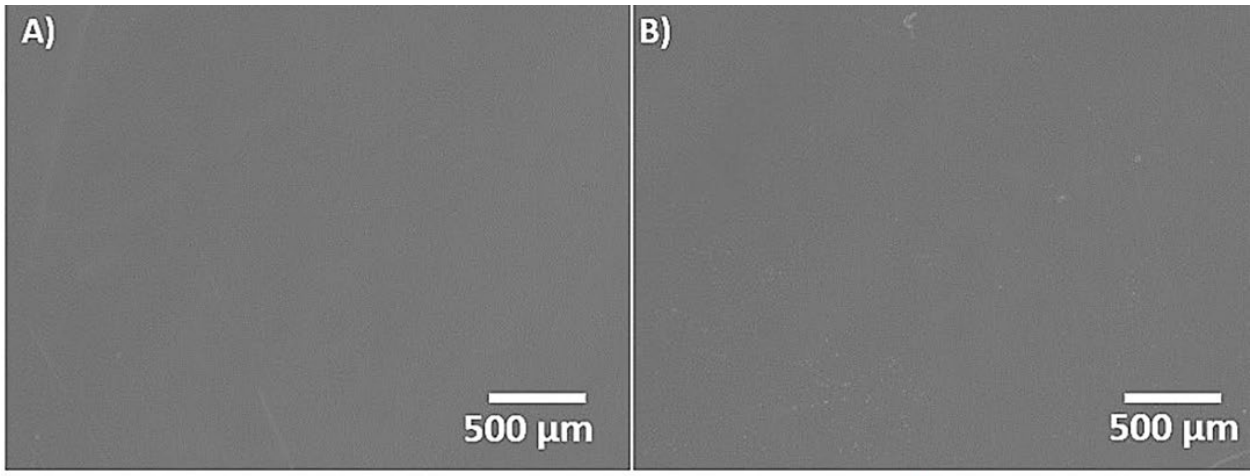

Figure S1: Optical images **A)** before surface treatment, and **B)** after surface treatment.

 https://doi.org/10.69631/ipj.v2i2nr71

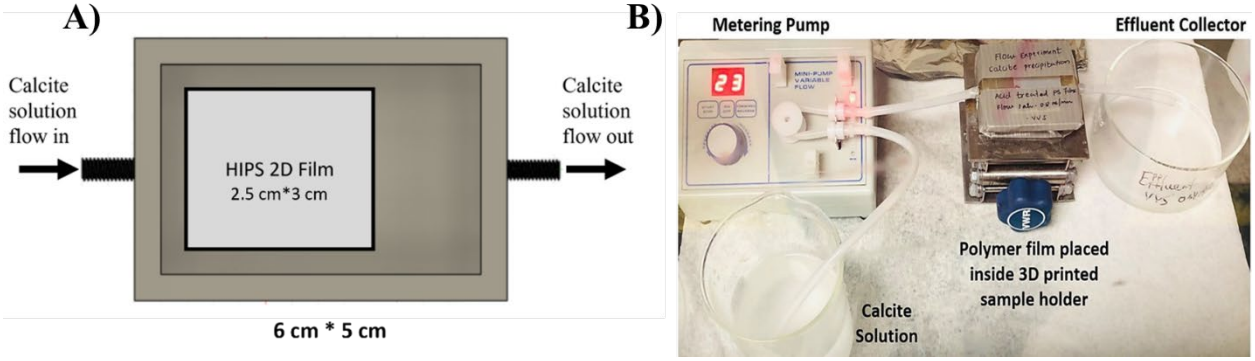

Figure S2: A) Custom made sample holder, and **B)** Top view of calcite flow reactor chamber design showing HIPS films (2.5 cm * 3 cm) fixed and calcite solution flow in and out. Chamber dimensions are 6 cm x 5 cm.

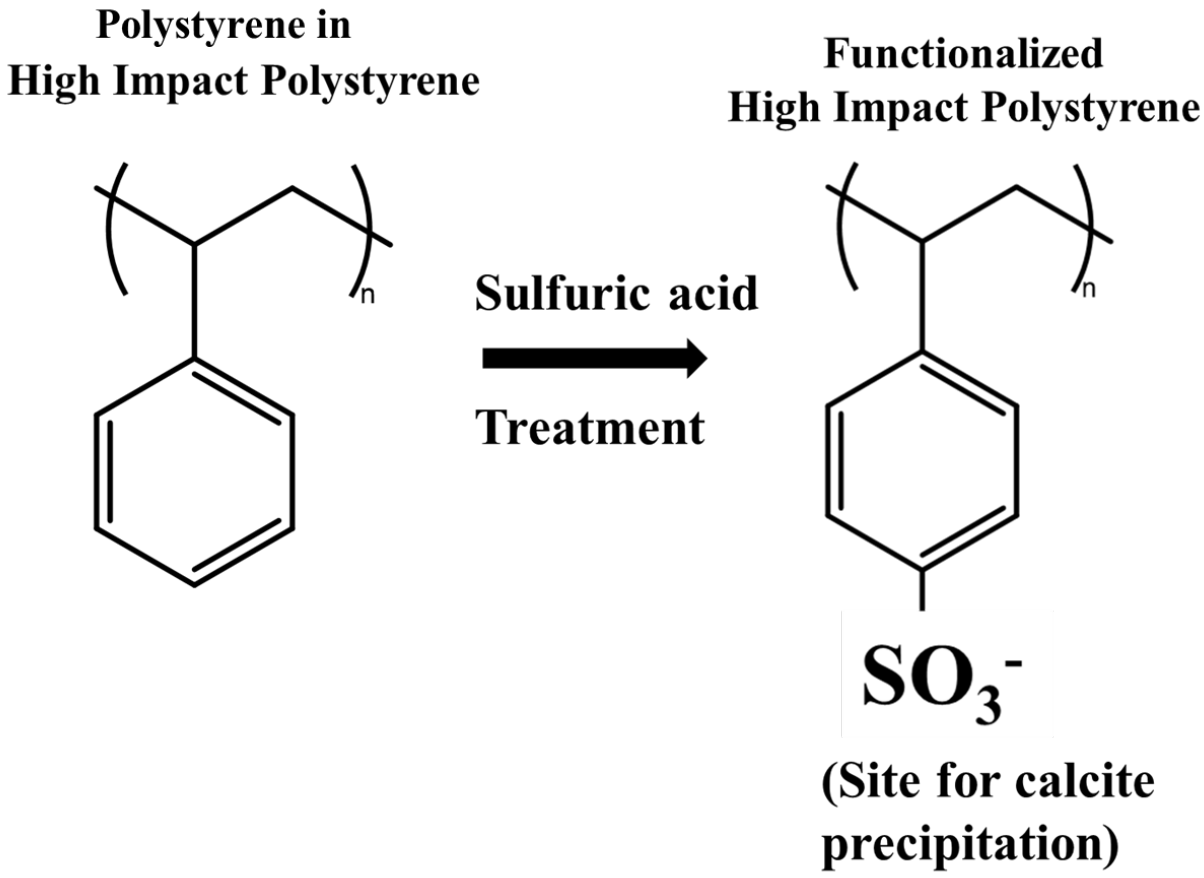

Figure S3: Schematic for potential calcite precipitation mechanism.

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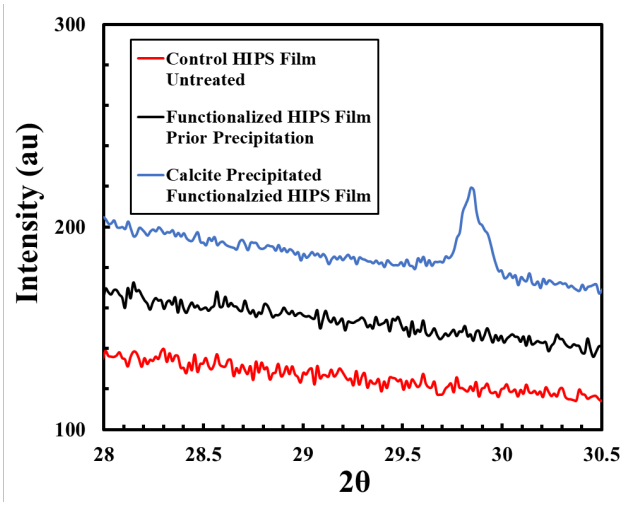

Figure S4: XRD comparison of control HIPS film untreated (red), 2 days functionalized HIPS film prior precipitation (black), 2 days functionalized HIPS film after precipitation (blue) with slight offset in the 2 theta due to the sample geometrical error.

Table S1: Identical experimental conditions for the calcite precipitation experiments in 3D-printed porous media.

Sample no.	Functionalization time (days)	Experimental time (hours)	Saturation index of the solution	Flow rate (mL/min)	Porosity (%)
F-1	7	96	3.15	1.3±0.07	31.2
F-2	7	96	3.15	1.2±0.02	30.0
U-1	7	96	3.15	1.3±0.02	29.0
U-2	7	96	3.15	1.2±0.03	33.5

Table S2: Surface energy for HIPS after functionalization from measured contact angles.

Time (days)	Contact angle (°)	Standard deviation (°)	Calculated Surface energy of the film γ_{sv} (mJ/m^2)
0	77.98 ± 0.6	0.6	58.46971
1	74.52 ± 0.18	0.18	62.71032
2	67.67 ± 0.36	0.36	70.87171
3	66.85 ± 0.02	0.02	71.81889
4	64.58 ± 0.36	0.36	74.42619
5	62.61 ± 0.64	0.64	76.64964
6	61.32 ± 0.47	0.47	78.0845
7	59.08 ± 0.8	0.8	80.5339
8	57.39 ± 0.37	0.37	82.34456
9	56.29 ± 0.2	0.2	83.51025
10	56.36 ± 0.12	0.12	83.4316
11	57.21 ± 0.38	0.38	82.54074
12	57.48 ± 0.25	0.25	82.25428
15	57.56 ± 0.4	0.4	82.16393

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Table S3: Quantification of calcite growth on surface functionalized 2D films.

Functionalization time (hours)	Experiment run time (hours)	Average precipitation (mg)	Standard deviation (mg)
0	24	0.350	0.173
24	1	0.265	0.150
	2	0.750	0.173
	4	1.06	0.095
	8	2.88	0.129
	24	2.25	0.443
48	1	0.2	0.150
	2	0.68	0.287
	4	1.10	0.231
	8	2.866	0.171
	24	6.44	2.390
96	1	0.98	0.170
	2	1.23	0.216
	4	2.84	0.350
	8	3.60	0.883
	24	7.56	1.340
600	1	1.075	0.355
	2	2.025	0.236
	4	3.533	0.503
	8	5.860	1.451
	24	10.475	3.501

Table S4: Calcite growth and contact angles of polymer films

Polymer films	Contact angle (°)	Average weight of calcite precipitated (mg)
Unfunctionalized SBS	77.96	2.3
Unfunctionalized PLA	56.87	5.67
Unfunctionalized HIPS	76.76	0.35
10 Days functionalized HIPS	56.36	6.8

MATLAB code link for the image analysis

https://github.com/alnahian39/CodeForPorousMedia