

ELECTRONIC SUPPLEMENTARY INFORMATION (ESI)

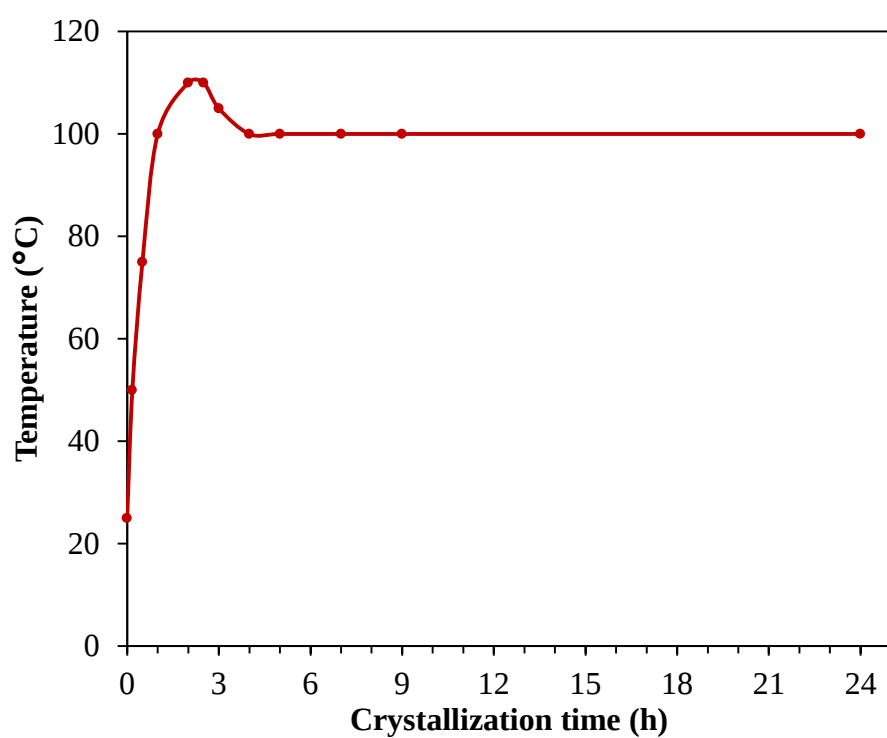
Knobby surfaced, mesoporous, single-phase GIS-NaP1 zeolite
microsphere synthesis and characterization for H₂ gas adsorption

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SI1. Heating profile used for the crystallization of GIS-NaP1 zeolite.

SI2

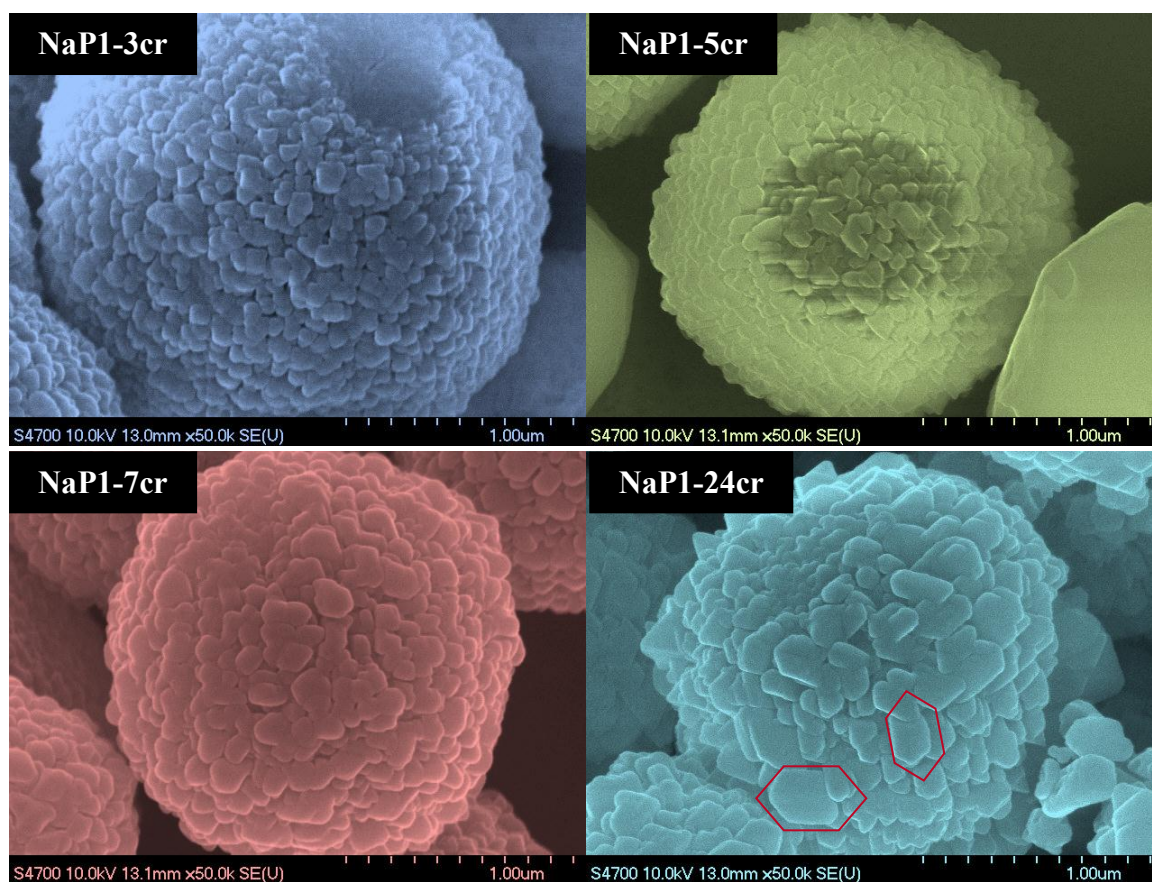
The sample code of GIS-NaP1 zeolite specimens obtained from hydrothermal reaction mixture of molar composition $14\text{Na}_2\text{O}:\text{Al}_2\text{O}_3:10\text{SiO}_2:840\text{H}_2\text{O}$ at different stages of aging and crystallization of hydrogel.

Aging time (h)	Crystallization time (h)	Stirring Speed	Material code
1.0	-	1800 rpm	NaP1-1ag
8.0	-	1800 rpm	NaP1-8ag
24.0	-	1800 rpm	NaP1-24ag
24.0	0.5	1000 rpm	NaP1-0.5cr
24.0	1.0	1000 rpm	NaP1-1cr
24.0	2.0	1000 rpm	NaP1-2cr
24.0	3.0	1000 rpm	NaP1-3cr
24.0	5.0	1000 rpm	NaP1-5cr
24.0	7.0	1000 rpm	NaP1-7cr
24.0	24.0	1000 rpm	NaP1-24cr

SI3

Values of crystallite size (D) obtained from Scherrer equation and relative intensity.

Specimen	Peak	B (°)	D (nm)	Relative crystallinity (%)
NaP1-3cr	28.11	0.389	24.4	35.92
NaP1-5cr	28.00	0.383	24.8	39.78
NaP1-7cr	28.00	0.412	24.4	86.81
NaP1-24cr	28.00	0.378	27.4	100.00



SI4. High magnification images of NaP1-3cr (3 h crystallization), NaP1-5cr (5 h crystallization), NaP1-7cr (7 h crystallization) and NaP1-24cr (24 h crystallization).

SI5

Elemental analysis data in terms of atomic percentage of all the selected area (spherical GIS-NaP1 phase and crystalline impurity) as well as bulk sample of NaP1-3cr, NaP1-5cr, NaP1-7cr, and NaP1-24cr

<i>Element</i>	<i>NaP1-3cr</i>			<i>NaP1-5cr</i>			<i>NaP1-7cr</i>			<i>NaP1-24cr</i>		
	Sphere	Impurity	Bulk	Sphere	Impurity	Bulk	Sphere	Impurity	Bulk	1st Sphere	2 nd Sphere	Bulk
<i>O</i>	70.34	66.84	67.11	65.96	68.49	65.58	66.55	65.87	68.58	67.79	67.75	64.38
<i>Na</i>	8.03	8.52	8.15	9.57	8.39	10.17	9.75	9.18	8.15	9.24	9.22	10.49
<i>Al</i>	8.28	8.98	8.94	9.35	8.79	9.38	8.90	8.22	8.54	8.06	8.06	8.80
<i>Si</i>	13.35	15.66	15.80	15.12	14.33	14.87	14.80	16.73	14.74	14.92	14.94	16.33
<i>Si/Al</i>	1.61	1.74	1.77	1.62	1.63	1.59	1.66	2.04	1.73	1.85	1.85	1.86

SI6

Physical properties of single-phase GIS-NaP1 zeolite obtained from argon adsorption-desorption studies at 473 K and 573 K degassing temperature.

Physical parameters	Degassing temperature	
	473 K	573 K
Langmuir surface area ($\text{m}^2 \text{g}^{-1}$)	29.86	30.42
Total pore volume ($\text{cm}^3 \text{g}^{-1}$) ($P/P_0 = 0.995$)	0.0842	0.0822
Micropore volume ($\text{cm}^3 \text{g}^{-1}$)	0.0009	0.0001
Mesopore volume ($\text{cm}^3 \text{g}^{-1}$)	0.0833	0.0821