Supplementary Materials

S1. Titration of the synthetized product

The synthesis solid product (1.9201 g) was put in a furnace and kept at 1000 °C for 2 h in order to completely decompose CaHS. XRD on the resulting product is reported in Figure S1 revealing the presence of CaO and $CaSO_4$.

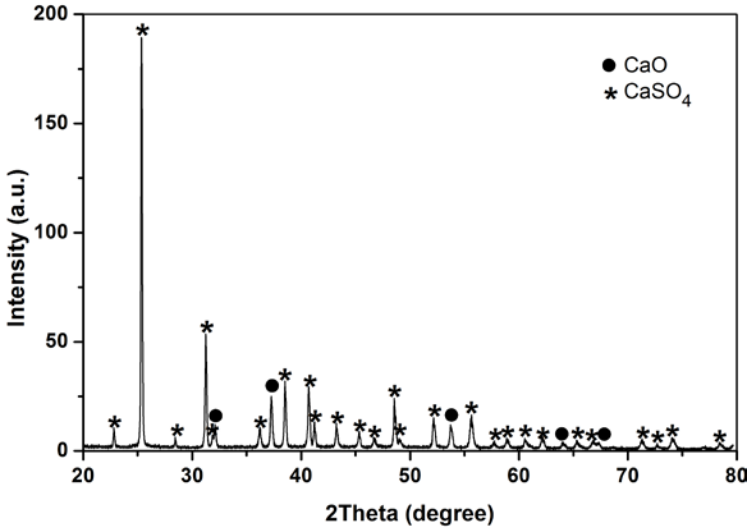


Figure S1. XRD diffractogram of CaHS after thermal treatment at 1000 °C.

The so obtained powder was dissolved in 20 mL of HCl (38 %); the mixture was diluted and boiled under magnetic stirring until clarification. The temperature of the solution was then set at about 65 °C, it was added 30 mL of an ammonium oxalate (2 g) solution and few drops of methyl red. After that, the solution was neutralised with NH_3 until the solution from red turned to yellow and left under stirring for about 1 h, maintaining a temperature of about 65 °C. The precipitation of calcium oxalate was relatively fast. pH was monitored through litmus paper to verify it was not changed appreciably.

The obtained mixture was cooled and filtered by decantation, washing with 30 mL of cold water. The filter was washed with 20 mL of hot H_2SO_4 (4.5 M) and with water to recover, respectively, dissolving and mechanically removing any residual calcium oxalated remained on the filter. The so formed mixture was diluted to 200 mL, heated to 60 °C and, as clarification occurred, titrated with a standardised $KMnO_4$ solution (1.012 N) until the solution turned pink permanently.

S2. Thermogravimetric dynamic vapor system tests

The dehydration/hydration cycles were performed in isothermal mode, at 30 °C, and varying the RH from 0 to 90%. The material has equilibrated at each selected RH value. The experimental RH profile as function of time is reported in Figure S2.

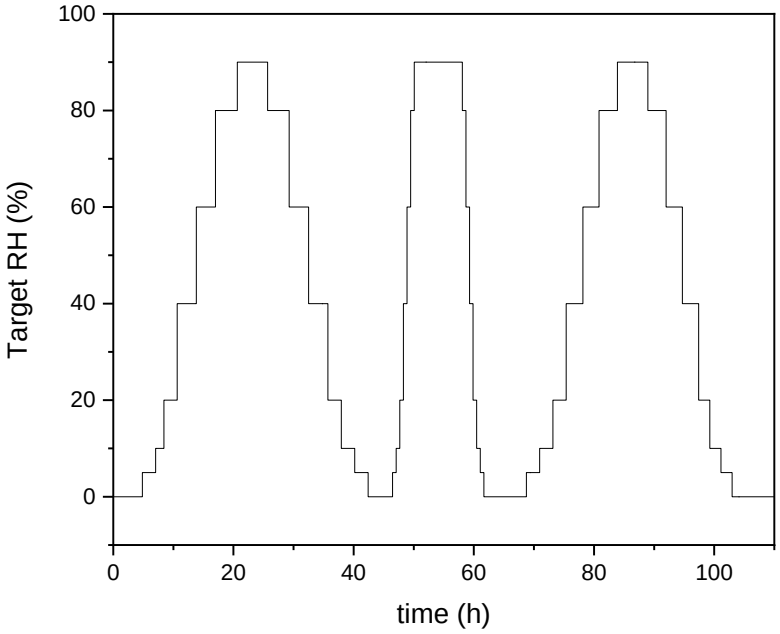


Figure S2. DVS RH(%) profiles as function of time.

S3. XRD analysis

XRD analysis was performed on dehydrated calcium salt (CaHS-D) at 150 °C for two hours. The material shows an amorphous structure.

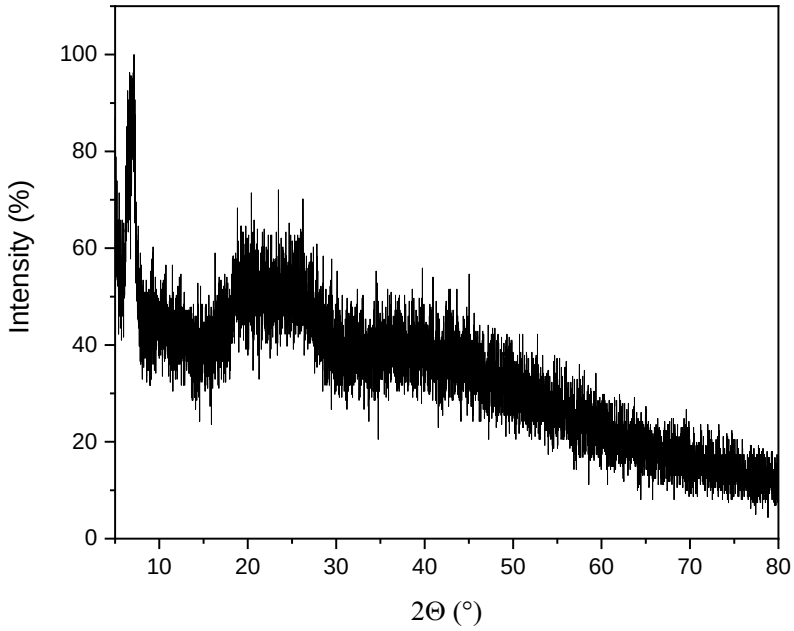


Figure S3 **XRD diffractogram of dehydrated CaHS**

S4. XRD Tables

Table S1. List of the d-spacing and Miller indexes for Na2HS (JCPDS # 71-1637).

2θ (°)	d (Å)	h	k	l
4.760	18.54940	0	0	1
5.778	15.28220	2	0	0
7.466	11.83080	2	0	-1
7.512	11.75920	2	0	1
9.528	9.27471	0	0	2
11.119	7.95062	2	0	-2
11.181	7.90710	2	0	2
11.571	7.64108	4	0	0
12.491	7.08057	4	0	-1
12.546	7.04979	4	0	1
14.313	6.18314	0	0	3
14.964	5.91541	4	0	-2
15.056	5.87960	4	0	2
15.413	5.74414	2	0	-3
15.480	5.71948	2	0	3
17.394	5.09406	6	0	0
18.015	4.91997	6	0	-1
18.072	4.90445	6	0	1
18.387	4.82119	4	0	-3

18.500	4.79211	4	0	3
18.881	4.69620	1	1	0
19.123	4.63736	0	0	4
19.478	4.55359	1	1	-1
19.487	4.55154	1	1	1
19.816	4.47662	6	0	-2
19.921	4.45331	6	0	2
19.958	4.44520	2	0	-4
20.027	4.42994	2	0	4
20.605	4.30705	3	1	0
21.147	4.19786	3	1	-1
21.171	4.19303	3	1	1
21.180	4.19133	1	1	-2
21.196	4.18812	1	1	2
22.470	3.95355	4	0	4
22.666	3.91973	6	0	3
22.722	3.91029	3	1	-2
22.768	3.90249	3	1	2
23.263	3.82054	8	0	0
23.694	3.75204	5	1	0
23.729	3.74658	8	0	-1
23.761	3.74152	1	1	-3
23.783	3.7381	1	1	3
23.788	3.73743	8	0	1
23.967	3.70988	0	0	5
24.163	3.68028	5	1	-1
24.199	3.67485	5	1	1
24.709	3.60007	2	0	5
25.133	3.54029	8	0	-2
25.146	3.53849	3	1	-3
25.209	3.52982	3	1	3
25.245	3.52489	8	0	2
25.555	3.48281	5	1	-2
26.043	3.41871	6	0	4
26.755	3.32925	4	0	5
26.986	3.30128	1	1	-4
27.012	3.29815	1	1	4
27.341	3.25918	8	0	-3
27.496	3.24119	8	0	3
27.721	3.21537	7	1	0
27.742	3.21308	5	1	-3
27.837	3.20227	5	1	3
28.121	3.17056	7	1	-1
28.165	3.1657	7	1	1
28.217	3.15999	3	1	-4
28.292	3.15175	3	1	4

28.855	3.09157	0	0	6
29.194	3.05643	10	0	0
29.333	3.04228	7	1	-2
29.416	3.03384	2	0	-6
29.418	3.03371	7	1	2
29.489	3.02655	2	0	6
29.567	3.01877	10	0	-1
29.677	3.00775	6	0	-5
29.857	2.99009	6	0	5
30.191	2.9577	8	0	-4
30.38	2.9398	8	0	4
30.566	2.92231	5	1	-4
30.672	2.91246	1	1	-5
30.682	2.91147	5	1	4
30.701	2.90977	1	1	5
30.718	2.90822	10	0	-2
30.834	2.89755	10	0	2
31.39	2.8474	7	1	3
31.767	2.81454	3	1	-5
31.851	2.80727	3	1	5
32.374	2.76311	9	1	0
32.572	2.74672	10	0	-3
32.716	2.73497	9	1	-1
32.766	2.73096	9	1	1
33.538	2.66981	8	0	-5
33.773	2.65175	9	1	-2
33.794	2.65021	6	0	-6
33.797	2.64992	0	0	7
33.823	2.648	7	1	-4
33.869	2.64445	9	1	2
33.887	2.64309	5	1	-5
34.02	2.63307	5	1	5
34.695	2.58338	1	1	-6
34.726	2.58113	1	1	6
35.032	2.55928	10	0	-4
35.206	2.54703	12	0	0
35.489	2.52742	9	1	-3
35.578	2.52125	12	0	1
35.626	2.51796	9	1	3
35.675	2.51466	3	1	-6
35.766	2.50844	3	1	6
36.495	2.45999	12	0	-2
36.615	2.45222	12	0	2
36.879	2.43527	7	1	-5
37.051	2.42432	7	1	5
37.27	2.4106	8	0	-6

37.462	2.39871	11	1	0
37.505	2.39605	8	0	6
37.742	2.38153	5	1	6
37.759	2.38052	11	1	-1
37.784	2.37897	9	1	-4
37.828	2.37632	0	2	0
37.958	2.36846	9	1	4
37.997	2.36616	10	0	-5
38.096	2.36019	12	0	-3
38.149	2.35706	0	2	1
38.153	2.35684	6	0	-7
38.237	2.35184	10	0	5
38.269	2.34993	12	0	3
38.3	2.3481	2	2	0
38.354	2.34493	6	0	7
38.613	2.32979	2	2	-1
38.623	2.32923	2	2	1
38.69	2.32531	11	1	-2
38.795	2.3193	11	1	2
38.978	2.3088	1	1	-7
39.011	2.30692	1	1	7
39.099	2.30196	0	2	2
39.23	2.29455	2	0	-8
39.305	2.29034	2	0	8
39.549	2.2768	2	2	-2
39.567	2.27577	2	2	2
39.688	2.26912	4	2	0
39.862	2.2596	3	1	-7
39.987	2.25283	4	2	-1
40.006	2.25183	4	2	1
40.22	2.24036	11	1	-3
40.258	2.23831	12	0	-4
40.346	2.23364	7	1	-6
40.371	2.23231	11	1	3
40.538	2.2235	7	1	6
40.555	2.2226	4	0	-8
40.578	2.22137	9	1	-5
40.64	2.21814	0	2	3
40.783	2.21069	9	1	5
40.892	2.20505	4	2	-2
40.928	2.20318	4	2	2
41.072	2.19583	2	2	-3
41.099	2.19445	2	2	3
41.321	2.18317	14	0	0
41.588	2.16976	14	0	-1
41.615	2.1684	5	1	-7

41.65	2.16665	14	0	1
41.771	2.16065	5	1	7
41.916	2.15353	6	2	0
42.198	2.1398	6	2	-1
42.224	2.13852	6	2	1
42.292	2.13522	11	1	-4
42.37	2.13147	4	2	-3
42.423	2.12894	4	2	3
42.486	2.12593	11	1	4
42.565	2.12216	14	0	2
42.71	2.11529	6	0	-8
42.879	2.10734	13	1	0
42.92	2.10544	6	0	8
43.06	2.09893	6	2	-2
43.112	2.09651	6	2	2
43.13	2.09566	2	2	-4
43.141	2.09518	13	1	-1
43.165	2.09406	2	2	4
43.172	2.09375	12	0	5
43.197	2.09257	13	1	1
43.475	2.07986	1	1	-8
43.509	2.07829	1	1	8
43.796	2.06536	9	1	-6
43.973	2.05743	13	1	-2
44.027	2.05505	9	1	6
44.084	2.05251	13	1	2
44.152	2.04953	7	1	-7
44.272	2.04423	2	0	-9
44.281	2.04386	3	1	-8
44.36	2.04038	7	1	7
44.376	2.03968	4	2	-4
44.382	2.0394	3	1	8
44.475	2.03536	6	2	-3
44.849	2.01926	11	1	-5
44.882	2.01784	8	2	0
45.08	2.00944	11	1	5
45.106	2.00835	10	0	-7
45.145	2.00671	8	2	-1
45.28	2.00102	0	2	5
45.399	1.99608	10	0	7
45.514	1.99131	13	1	3
45.668	1.98493	2	2	-5

Table S2. List of calculated d-spacing for CaHS.

2θ (°)	d (Å)
6.349	13.91007
6.4237	13.74848
8.7937	10.04771
9.11	9.699553
12.69	6.970099
14.53	6.091318
14.93	5.929009
15.07	5.874242
17.4627	5.074384
17.6277	5.027257
17.8215	4.973022
18.3855	4.82172
19.19122	4.621064
19.4228	4.566486
19.6514	4.513878
21.2396	4.179802
21.9314	4.049494
22.8518	3.888432
23.2277	3.826347
23.4593	3.789094
23.8624	3.72599
24.2083	3.673529
24.7858	3.58923
26.0251	3.421055
26.3409	3.380752
26.5725	3.351809
27.0327	3.295784
29.3126	3.044422
30.8978	2.891746
32.4204	2.759329
33.1109	2.703346
34.3193	2.610875
36.66	2.449366
38.7319	2.322976
39.8324	2.261296
41.1774	2.190487