Electronic Supplementary Information

Rapid surfactant-free synthesis of $Mg(OH)_2$ nanoplates and pseudomorphic dehydration to MgO.

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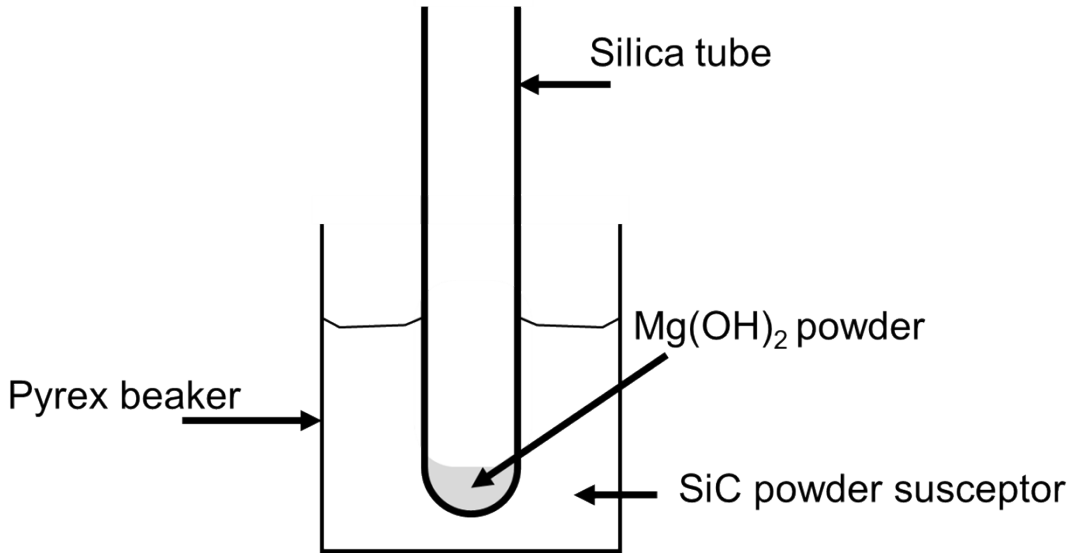

Fig. S1: Experimental set-up for the synthesis of MgO (**4**) in the MMC.

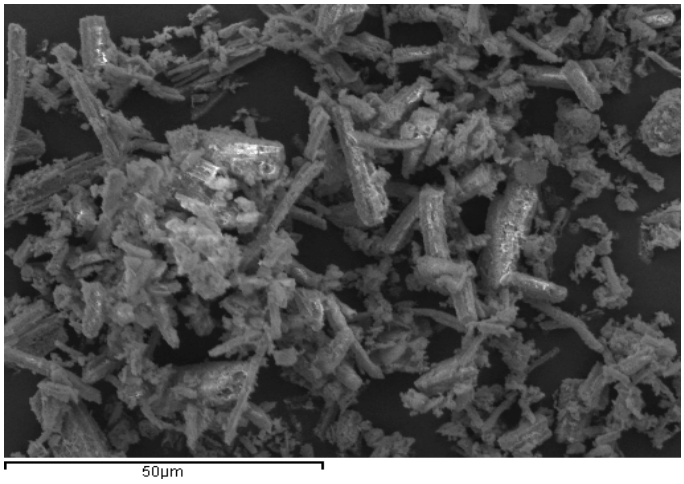

Fig. S2: SEM micrograph illustrating the morphology of the as-received MgO

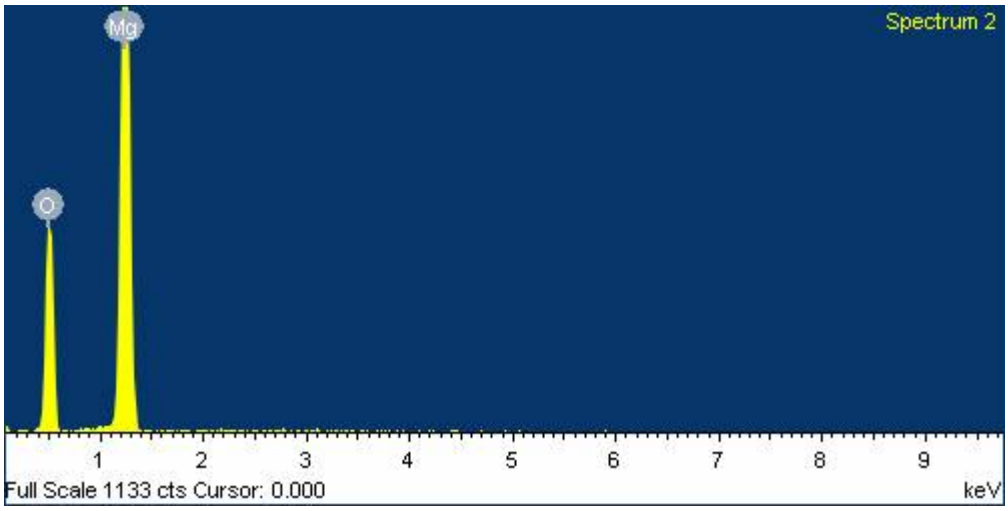

Fig S3: Representative EDX for commercial MgO

Table S1: Selected Peak Widths (FWHM) for commercial MgO

	hkl and Peak widths (FWHM) / °				
MgO (t=0)	111	200	220	311	222
	0.1584	0.1980	0.1584	0.1980	0.1584

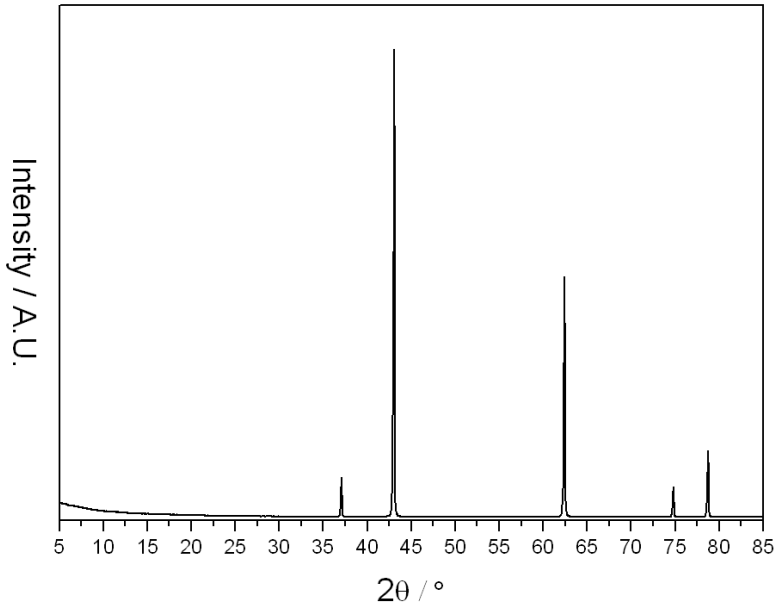

Fig S4: PXD pattern for commercial MgO used in the synthesis

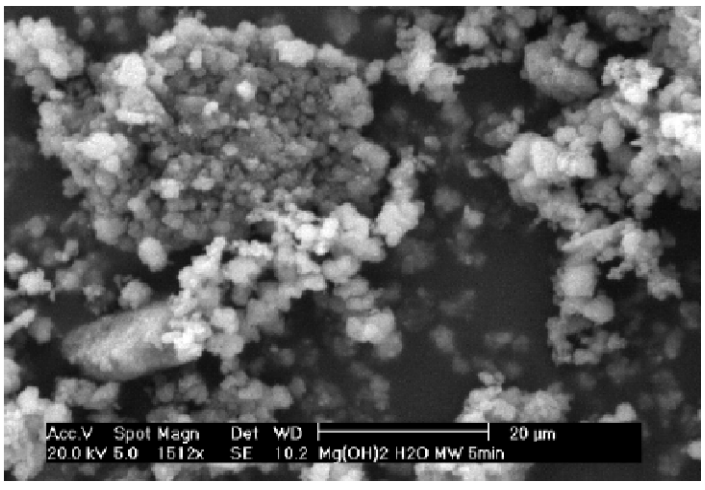

Fig. S5 SEM micrograph illustrating the morphology of a typical $Mg(OH)_2$/MgO product (**1**) obtained at intermediate reaction times at 750 W with 5 mins heating.

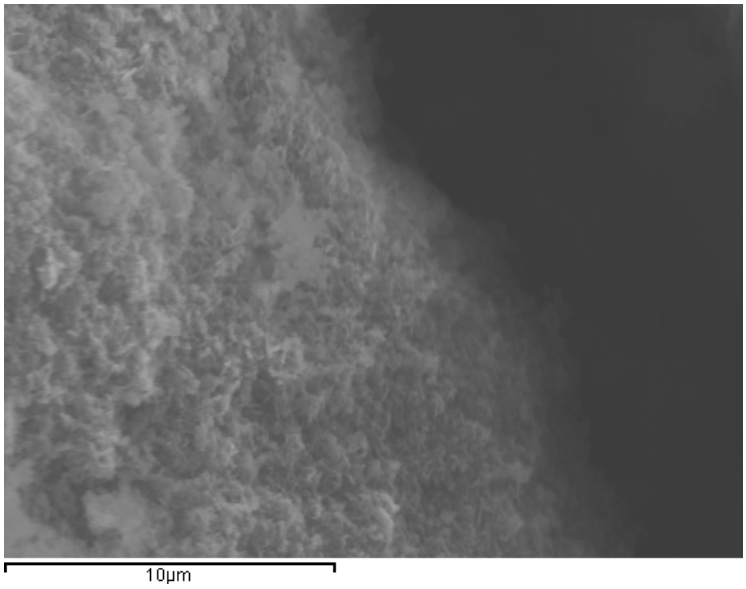

Fig S6: SEM micrograph illustrating the morphology of a typical $Mg(OH)_2$/MgO product obtained at 800 W with 1 minute of heating

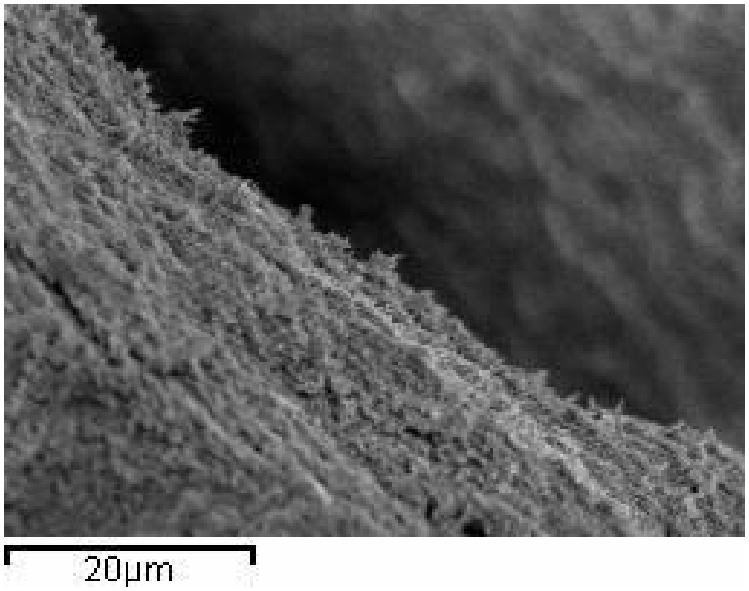

Fig S7: SEM micrograph illustrating the morphology of a typical $Mg(OH)_2$ product obtained at 800 W with 2 minutes heating

Table S2: Dependence of $Mg(OH)_2$ phase fraction (*vs*. MgO) on MW synthesis parameters.

Mass Mg used / g	Autoclave vol. / mL	MgO: H_2O molar ratio	Reaction time / min	Applied power / W	$Mg(OH)_2$ phase fraction / wt%	Mg:O ratio for nanoplates / at%
0.4	23	0.39	3	750	1	38:62
0.4	23	0.39	4	750	86	37:63
0.4	23	0.39	5	750	91	38:62
0.4	23	0.39	6	750	100	39:61
0.8	45	0.66	4	750	98	37:63
0.8	45	0.66	6	750	100	….
0.8	45	0.66	1	800	99	35:65
0.8	45	0.66	2	800	100	38:62
0.8	45	0.66	3	800	100	39:61
0.8	45	0.66	4	800	100	37:63

Table S3: Crystallographic data for sample **2**

Chemical Formula	$Mg(OH)_2$
Crystal System	Trigonal
Space Group	$P\bar{3}m1$
a **/ Å**	3.150(4)
c **/ Å**	4.774(9)
Volume / Å^3	41.0
Z	1
Formula Weight / g mol^{-1}	58.319
Calculated density, ρ / g cm^{-3}	2.360
No. of data	9573
No. of parameters	31
R_{wp}	0.0931
R_p	0.0361
χ^2	4.428

Table S4: Atomic parameters for **2** from Rietveld refinement.

Atom Type	Wyckoff symbol	x	y	Z	U_{iso}	Site Occupancy
Mg	1a	0	0	0	3.39(4)	1
O	2d	0.33	0.66	0.220(24)	3.73(7)	1
H	2d	0.33	0.66	0.434	4.10(6)	1

Table S5: Selected atomic distances (Å) and angles (°) for **2** from Rietveld Refinement

Mg-O1/ Å	2 x 2.0993 (6) 4 x 2.0995 (6)
Mg-H1/ Å	2 x 2.7568 (3) 2 x 2.7570 (3)
O-H1/ Å	2 x 1.0231 (12)
O1-Mg-O1 / °	1 x 97.21 (4) 2 x 97.22 (4)
O1-Mg-H1/ °	2 x 119.97 (3) 1 x 119.98 (3)

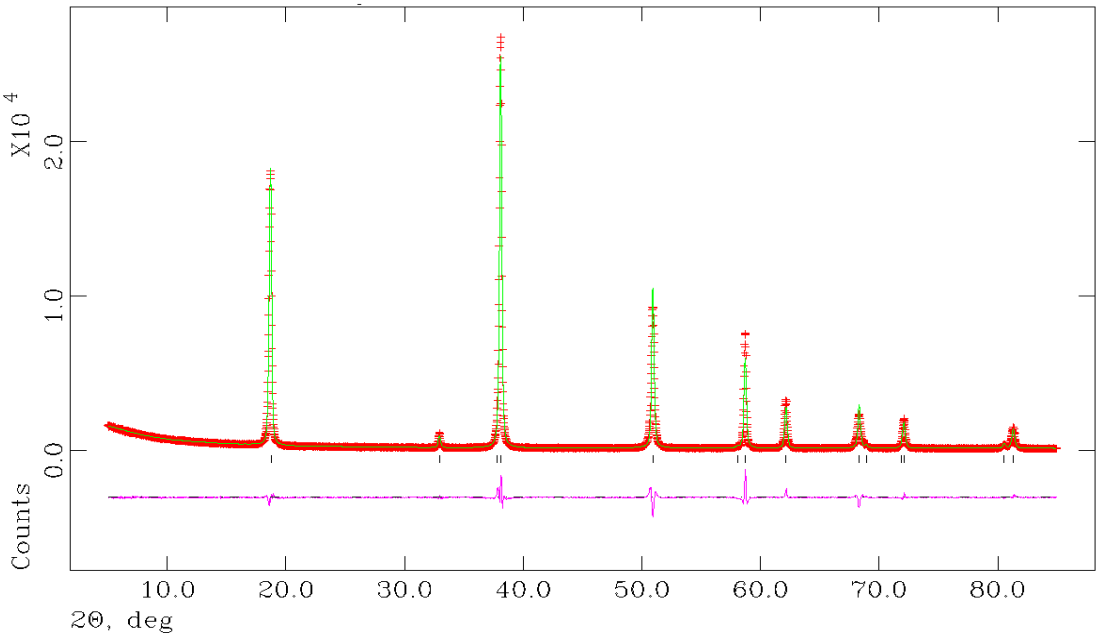

Fig. S8: Observed, Calculated and Difference plot for the refinement of sample **2.** Black tickmarks are reflections from $Mg(OH)_2$

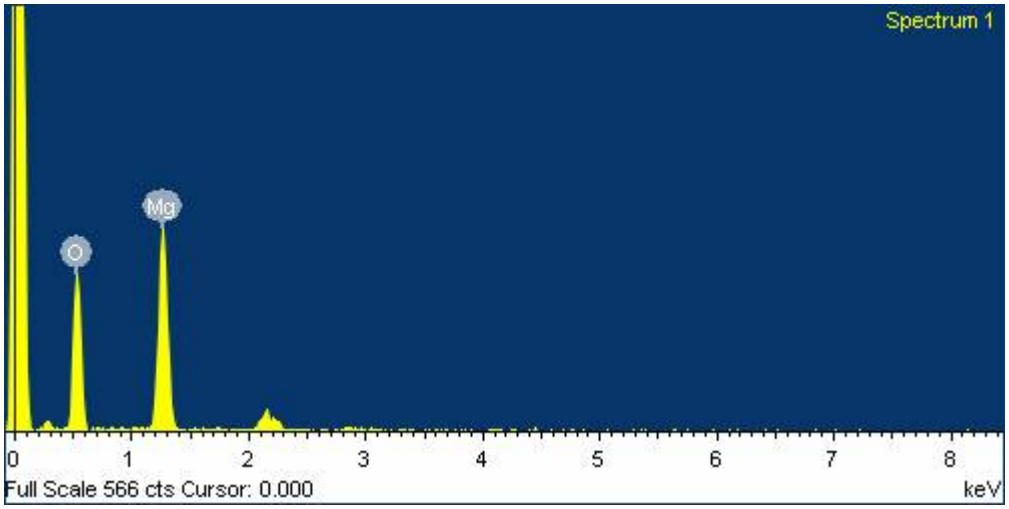

Fig. S9: Representative EDX spectrum for $Mg(OH)_2$ sample **2**

Table S6: Crystallographic data for sample **3**

Chemical Formula	MgO
Crystal System	Cubic
Space Group	$Fm\bar{3}m$
a **/ Å**	4.220(3)
Volume / Å^3	75.14(2)
Z	1
Formula Weight / g mol^{-1}	161.216
Calculated density, ρ / g cm^{-3}	3.563
No. of data	3889
No. of parameters	26
R_{wp}	0.0520
R_p	0.0386
χ^2	2.147

Table S7: Atomic parameters for **3** from Rietveld refinement.

Atom Type	**Wyckoff symbol**	**x**	**y**	**Z**	**U_{iso}**	**Site Occupancy**
Mg	4a	0	0	0	4.24(6)	1
O	4b	0.5	0.5	0.5	2.28(6)	1

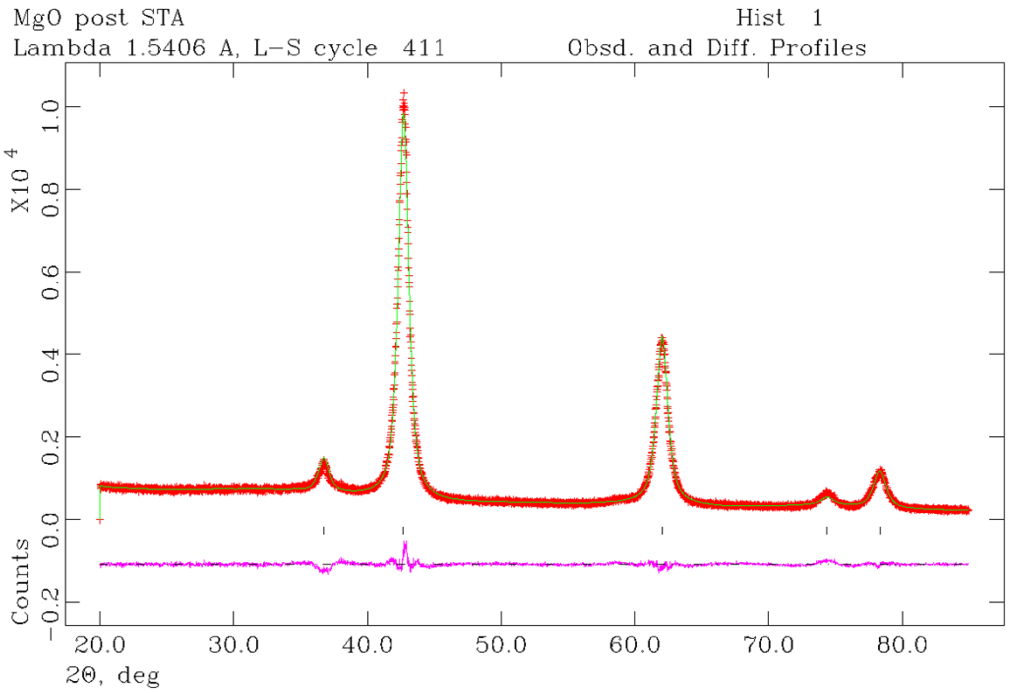

Fig. S10: OCD (Observed, Calculated, Difference) plot for the Rietveld Refinement for for MgO (sample **3**)

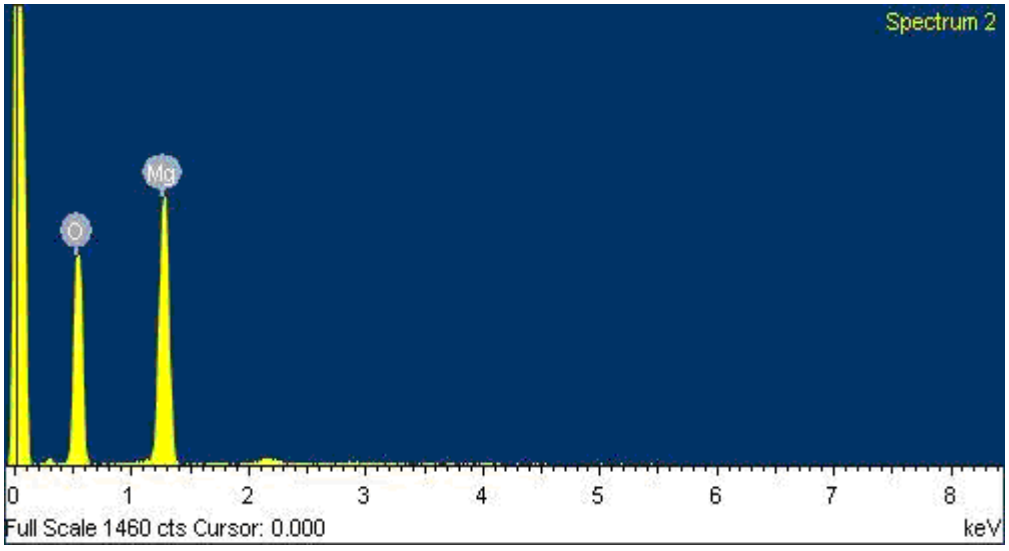

Fig. S11: Representative EDX for MgO (sample **3**)

Table S8: Crystallographic data for sample **4**

Chemical Formula	MgO
Crystal System	Cubic
Space Group	$Fm\bar{3}m$
a **/ Å**	4.220(3)
Volume / Å^3	75.07(1)
Z	1
Formula Weight / g mol^{-1}	161.216
Calculated density, ρ / g cm^{-3}	3.566
No. of data	3888
No. of parameters	23
R_{wp}	0.0642
R_p	0.0552
χ^2	3.086

Table S9: Atomic parameters for **4** from Rietveld refinement.

Atom Type	**Wyckoff symbol**	**x**	**y**	**Z**	**U_{iso}**	**Site Occupancy**
Mg	4a	0	0	0	2.63(4)	1
O	4b	0.5	0.5	0.5	1.59(4)	1

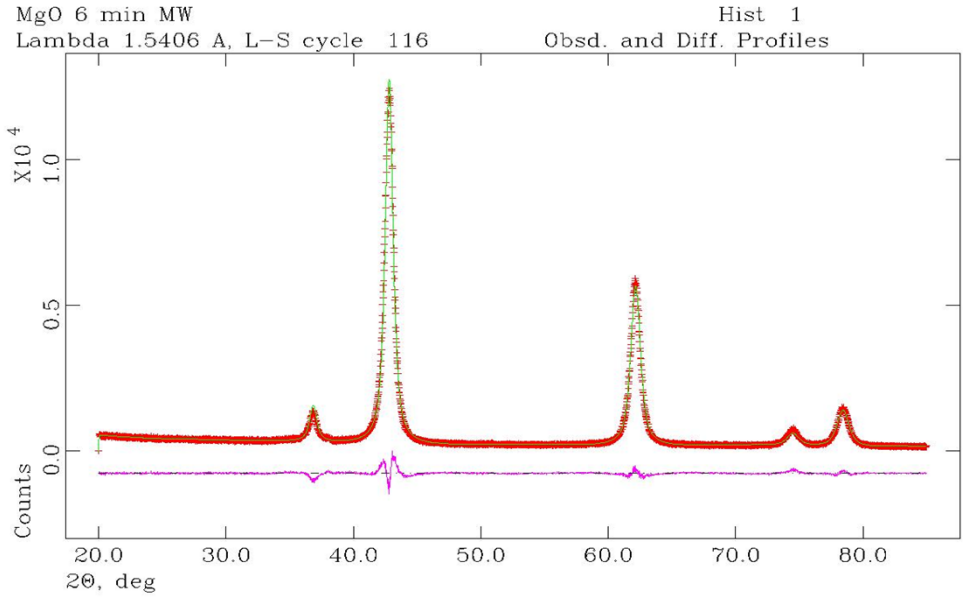

Fig. S12: OCD (Observed, Calculated, Difference) plot for the Rietveld Refinement for MgO (sample **4**)

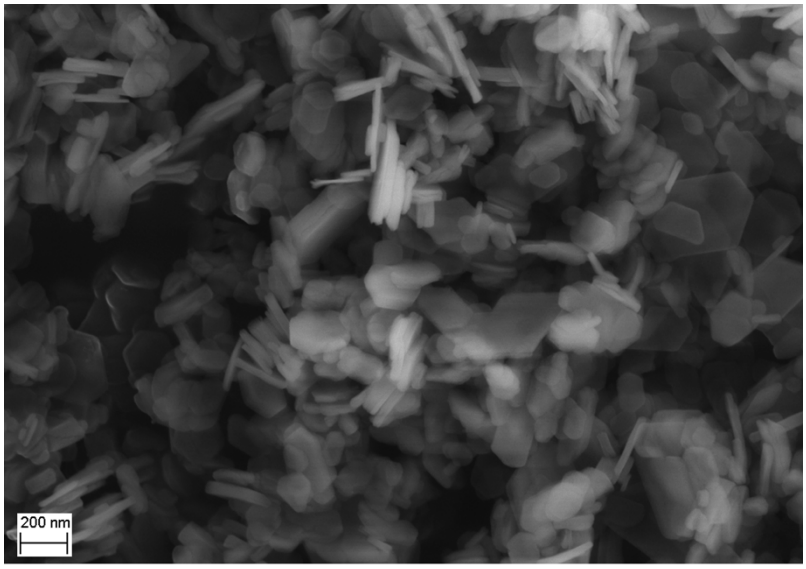

Fig S13: SEM micrograph illustrating the morphology of sample **4**

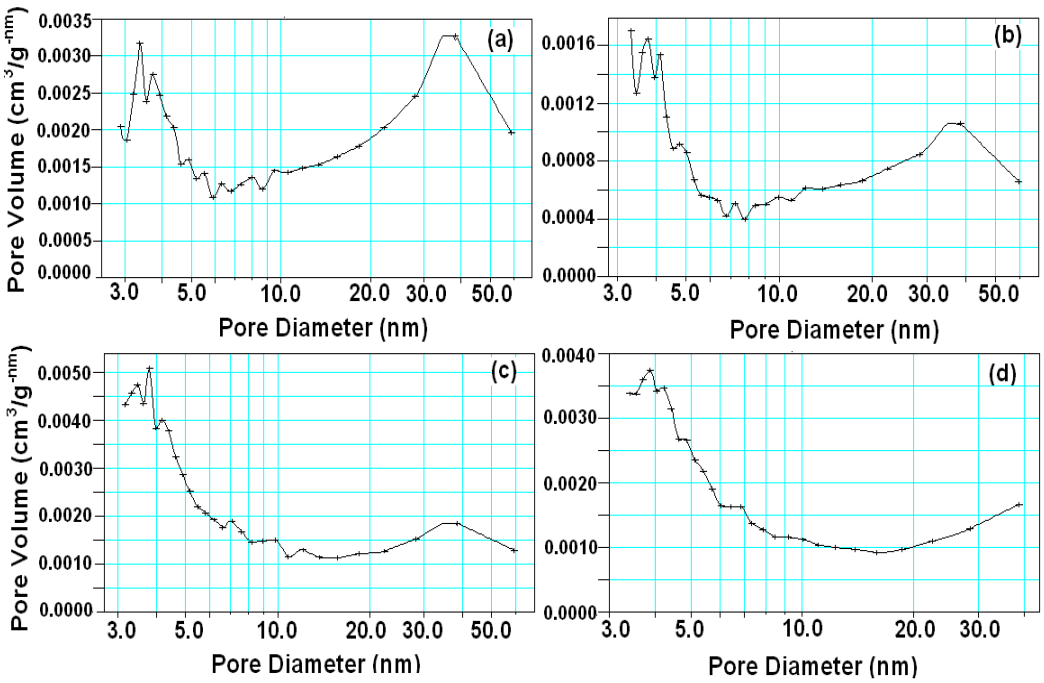

Fig S14: BJH desorption plots for 800 W samples: (a) 1 minute heating (Single Point Pore Volume = 0.196 cm^3g^{-1}, BJH pore volume= 0.201 $cm^3\ g^{-1}$) (b) 2 minutes heating (Single Point Pore Volume = 0.066 $cm^3\ g^{-1}$, BJH pore volume= 0.069 $cm^3\ g^{-1}$) (c) 3 minutes heating (Single Point Pore Volume = 0.128 $cm^3\ g^{-1}$, BJH pore volume= 0.137 $cm^3\ g^{-1}$) and (d) 4 minutes heating (Single Point Pore Volume = 0.112 $cm^3\ g^{-1}$, BJH pore volume= 0.066 $cm^3\ g^{-1}$)

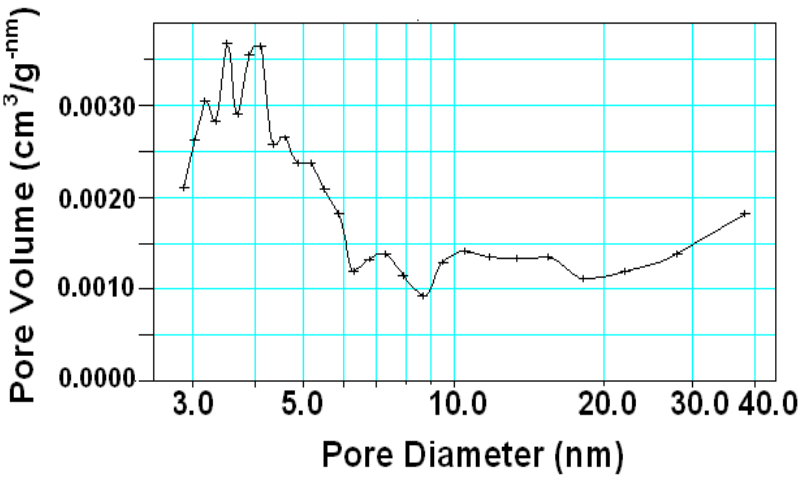

Fig S15: BJH desorption plot for sample **3** (MgO; Single Point Pore Volume = 0.134 $cm^3\ g^{-1}$, BJH pore volume= 0.073 $cm^3\ g^{-1}$).

Table S8: Selected Peak Widths (FWHM) for 800 W synthesised samples

	hkl and Peak Widths (FWHM)												
Irradiation time / min	001	100	002	102	012	110	111	103	200	201	004	022	202
1	0.1248	0.1536	0.0480	0.0960	0.0960	0.0864	0.2304	0.0960	0.1920	0.2304	0.1920	0.0960	0.0960
2	0.2856	0.1632	0.2856	0.3468	0.3468	0.2244	0.2856	0.1020	0.1224	0.1836	0.3264	0.1020	0.1020
3	0.0576	0.1536	0.1920	0.0864	0.0864	0.1056	0.2496	0.2880	0.1536	0.2112	0.2688	0.1920	0.1920
4	0.2304	0.1728	0.2112	0.2688	0.2688	0.1920	0.1344	0.3840	0.2304	0.3072	0.3072	0.4224	0.4224

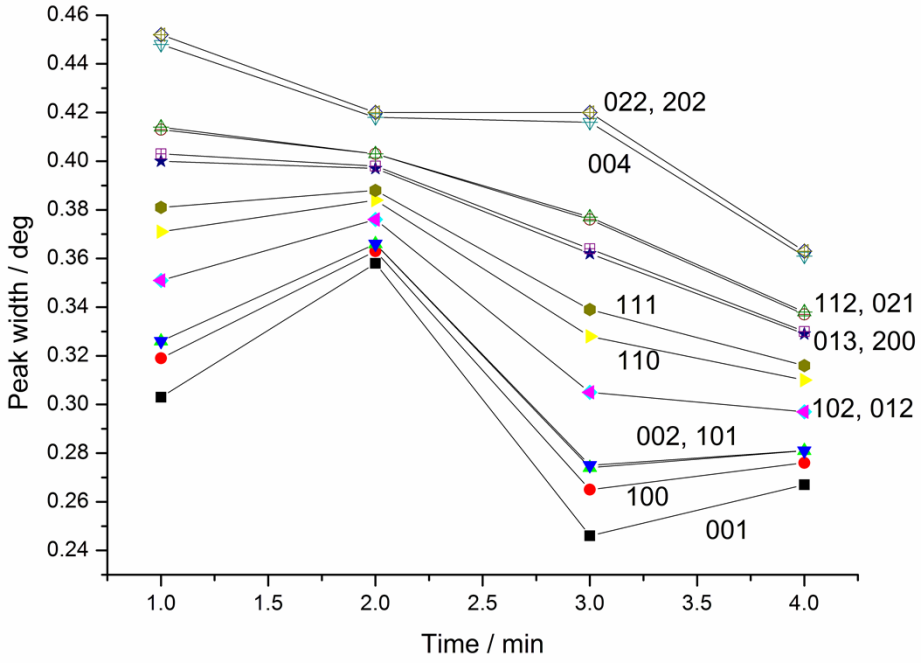

Fig S16: Plot of linewidths vs irradiation time for samples prepared at 800 W. Lines serve only as a guide to the eye.