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Supporting Information

Polysaccharide Stabilized Nanoparticles for Deacidification and Strengthening of Paper

Lunjakorn Amornkitbamrung[†], Tamilselvan Mohan[†], Silvo Hribernik[‡], Victoria Reichel[ζ], Damien Faivre[ζ], Adriana Gregorova[$], Patricia Engel,[β] Rupert Kargl[‡], Volker Ribitsch[†]*

[†]Institute of Chemistry, University of Graz, Heinrichstraße 28, AT-8010 Graz, Austria.

[‡]Faculty of Mechanical Engineering, Institute for Engineering Materials and Design, University of Maribor, Smetanova 17, 2000 Maribor, Slovenia.

[ζ]Department of Biomaterials, Max Planck Institute of Colloids and Interfaces Potsdam-Golm Science Park Am Mühlenberg 1 OT Golm 14469 Potsdam, Germany

[$]Institute for Chemistry and Technology of Materials, Graz University of Technology, Stremayrgasse 9, AT-8010 Graz, Austria

[β]European Research Centre for Book and Paper Conservation-Restoration, Donau-Universität Krems, Dr.-Karl-Dorrek-Straße 30, 3500 Krems, Austria

Corresponding Author

*tamilselvan.mohan@uni-graz.at
Karl-Franzens-University Graz
Institute of Chemistry
Heinrichstraße 28/III
A-8010 Graz/Austria
Phone: 0043 316 380 5413

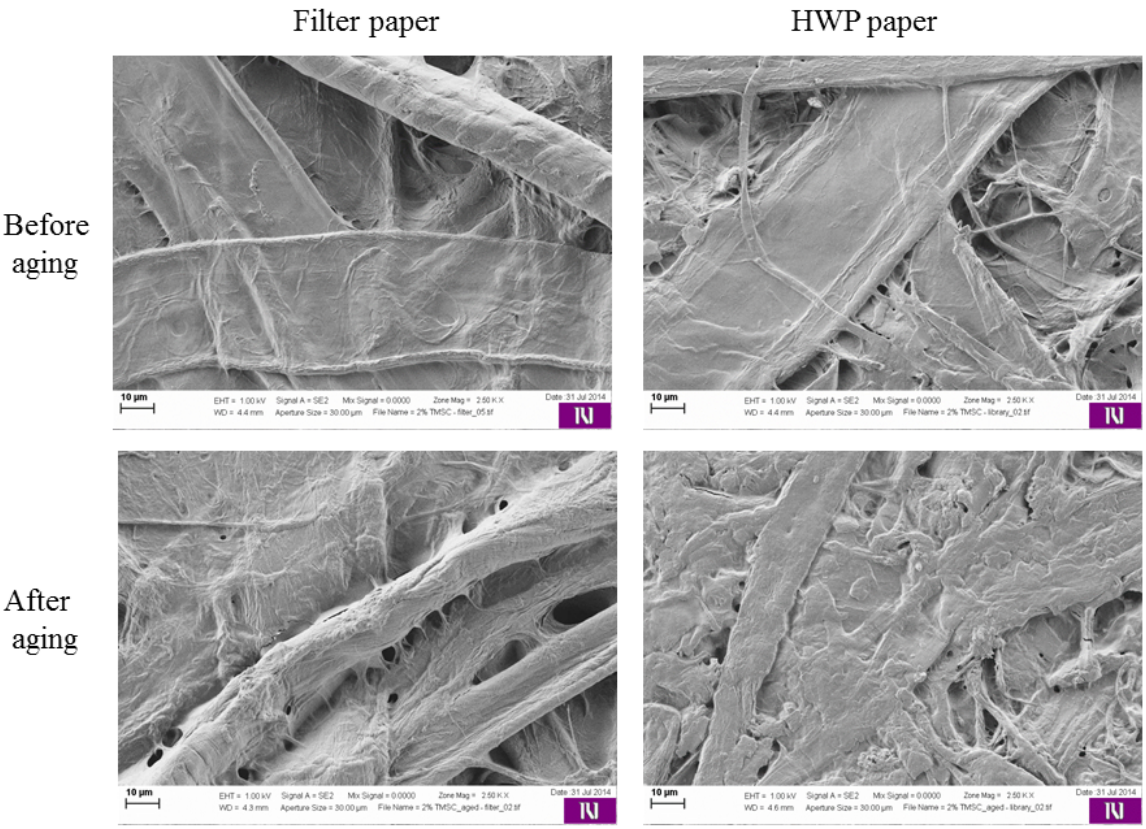

Figure S1. SEM micrographs of paper coated with TMSC before and after aging

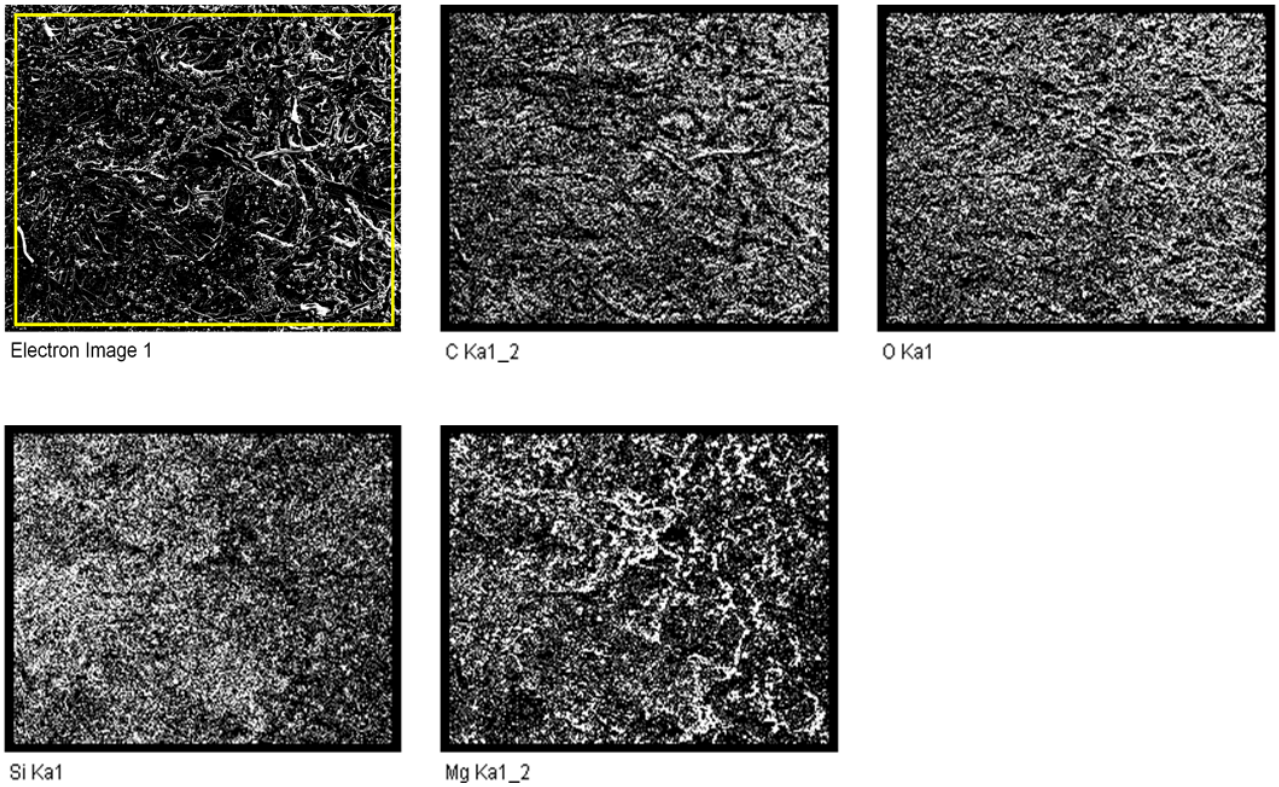

Figure S2. EDX elemental mapping of HWP paper coated with $Mg(OH)_2$-TMSC NP (unpeeled).

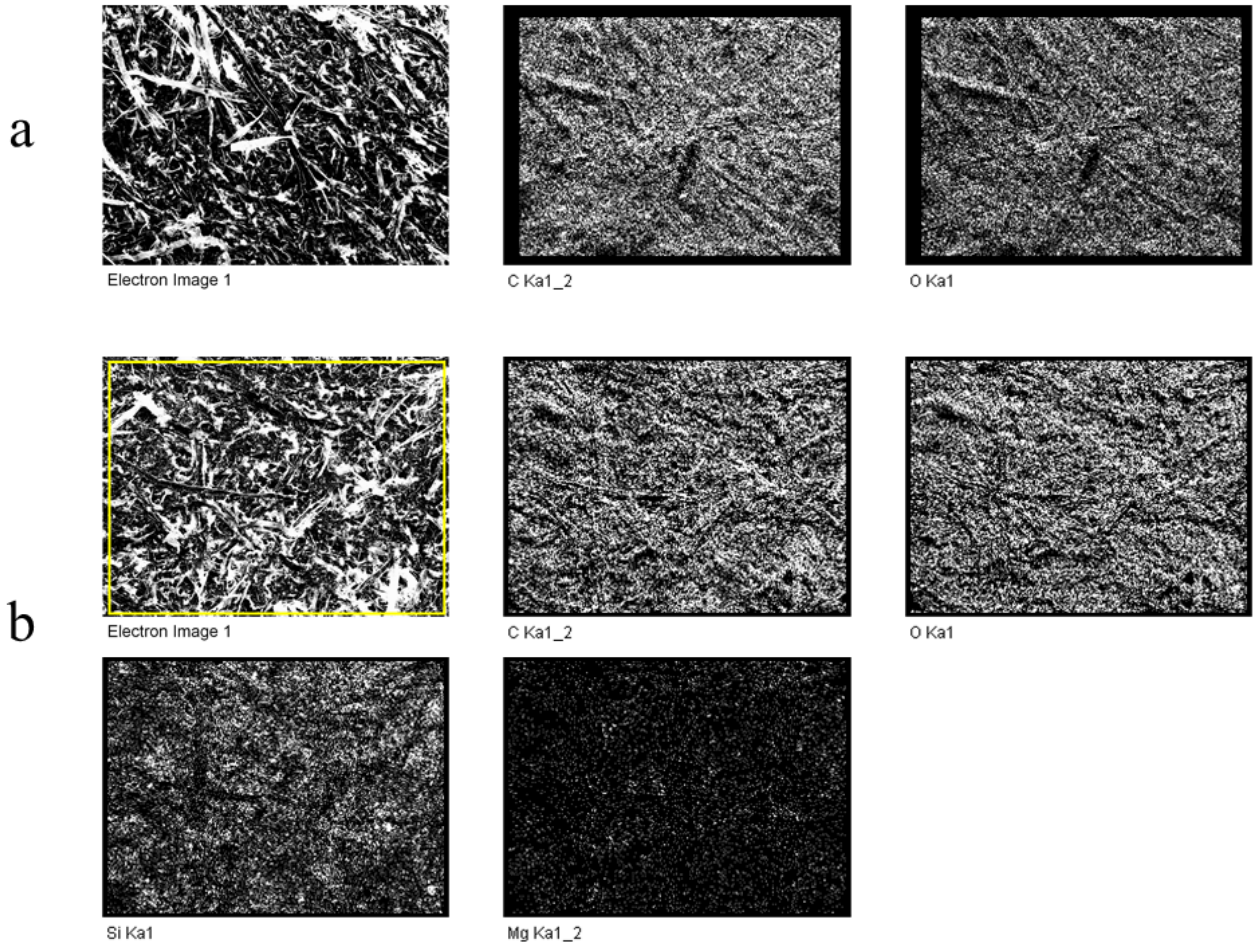

Figure S3. EDX elemental mapping of one time peeled samples, before aging. (a) original papers, (b) papers coated with $Mg(OH)_2$-TMSC NP.

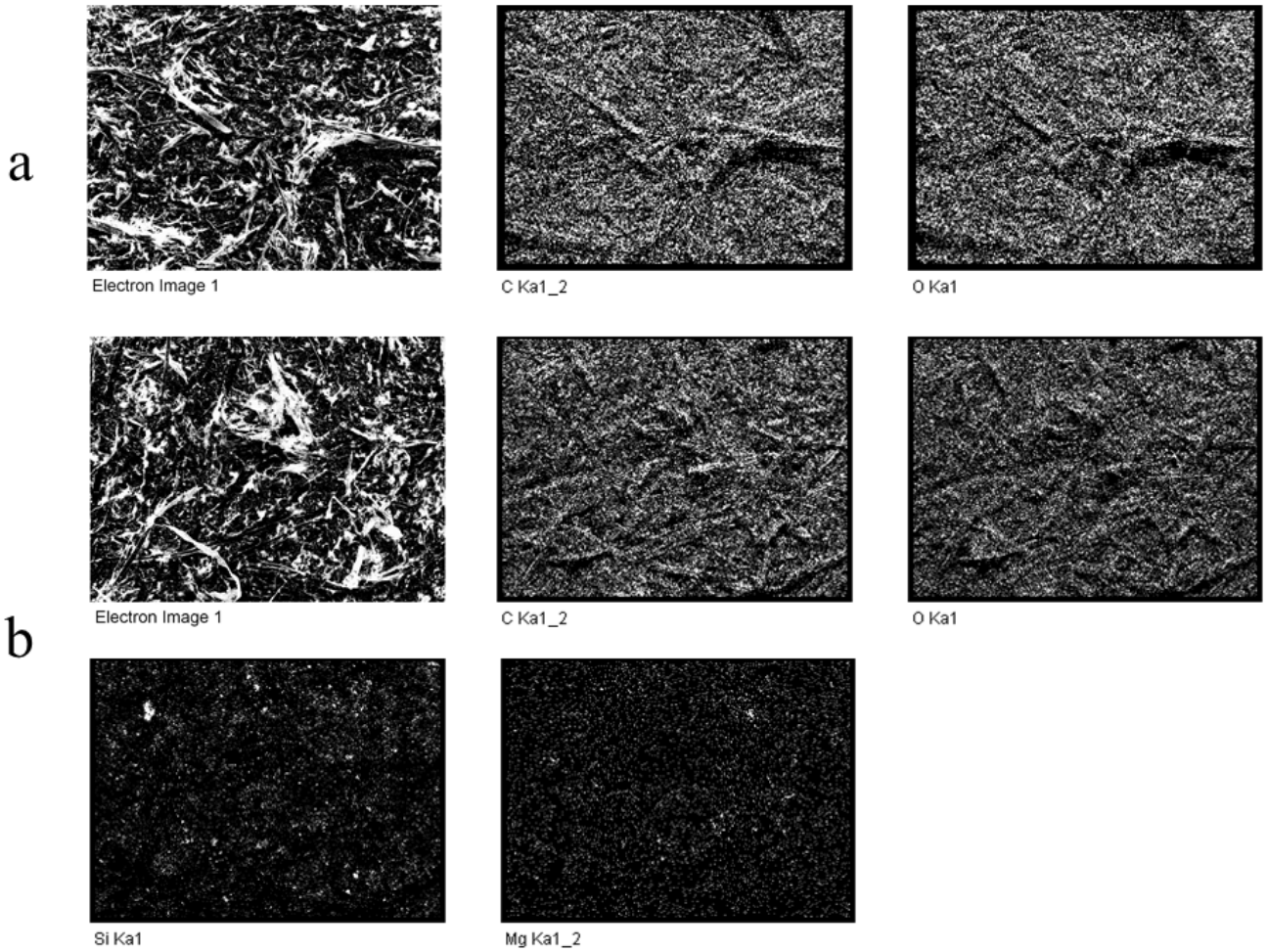

Figure S4. EDX elemental mapping of five times peeled samples, before aging. (a) original papers, (b) papers coated with $Mg(OH)_2$-TMSC NP.

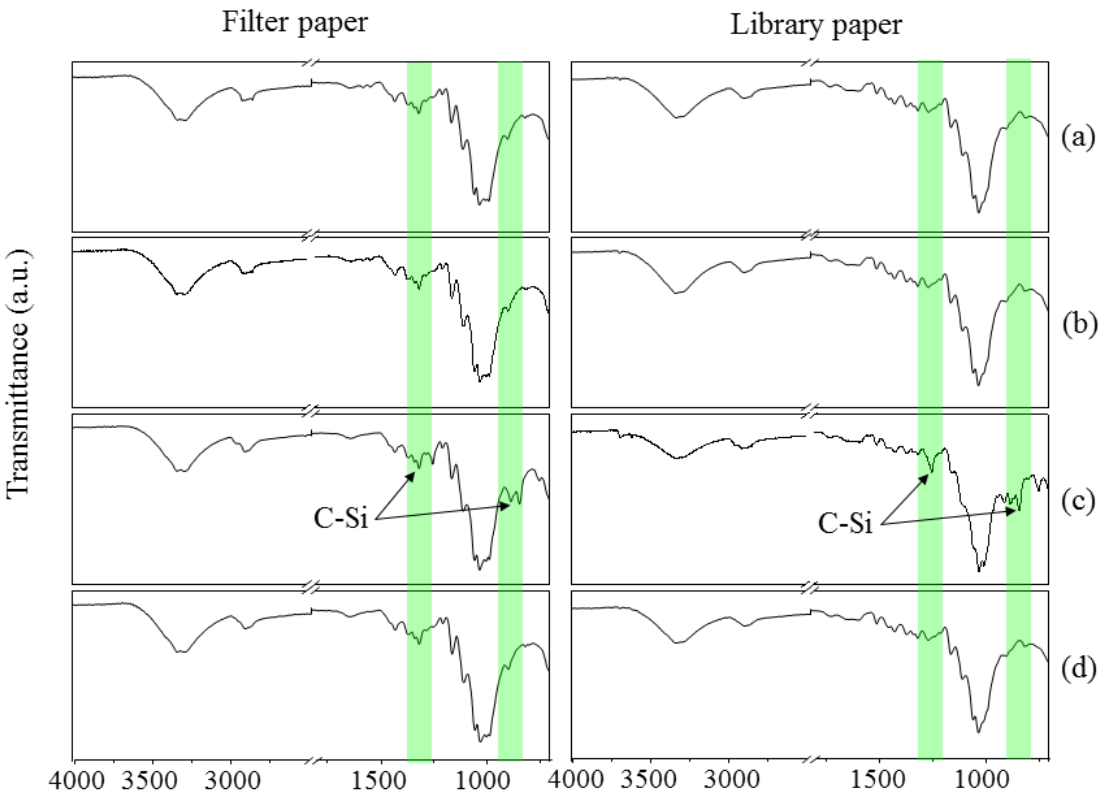

Figure S5. ATR-FTIR spectra of coated and uncoated paper before and after aging. (a) original papers, (b) original papers after aging, (c) papers coated with TMSC, (d) papers coated with TMSC after aging.

Table S1. CIE color coordinates of uncoated and coated papers (with TMSC-$Mg(OH)_2$ NPs, (1 % (w/v) $Mg(OH)_2$ and 2 % (w/v) TMSC))

Samples	Filter paper				HWP paper			
	L	a*	b*	ΔE*	L	a*	b*	ΔE*
Uncoated	96.3 ± 0.03	0.02 ± 0.01	3.7 ± 0.02	-	82.1 ± 0.1	3 ± 0.02	15.8 ± 0.001	-
Uncoated, aged	88.9 ± 0.02	3.0 ± 0.01	14.6 ± 0.1	13.4 ± 0.01	73.4 ± 0.01	5.7 ± 0.01	20.4 ± 0.02	10.3 ± 0.1
TMSC coated	96.3 ± 0.01	0.01 ± 0.001	3.9 ± 0.01	-	82.3 ± 0.2	3.1 ± 0.002	17.1 ± 0.01	-
TMSC coated, aged	87.6 ± 0.05	2.7 ± 0.02	13.1 ± 0.001	13 ± 0.1	73.4 ± 0.01	6.1 ± 0.1	21.1 ± 0.1	10.2 ± 0.1
TMSC-$Mg(OH)_2$ coated	96.3 ± 0.02	0.02 ± 0.001	4.0 ± 0.01	-	82.1 ± 0.01	3 ± 0.02	18 ± 0.01	-
TMSC-$Mg(OH)_2$ coated, aged	86.3 ± 0.01	2.5 ± 0.01	13.5 ± 0.01	14.1 ± 0.1	70.7 ± 0.1	5 ± 0.01	22.8 ± 0.02	12.5 ± 0.2

Table S2. CIE color coordinates of uncoated and coated papers. A particle concentration of 0.0625 and 0.25 % (w/v) were used for coating of filter and HWP paper.

Samples	Filter paper				HWP paper			
	L	a*	b*	ΔE*	L	a*	b*	ΔE*
TMSC-$Mg(OH)_2$ coated	96.4 ± 0.02	0.02 ± 0.001	3.8 ± 0.01	-	82.1 ± 0.1	3 ± 0.01	20.7 ± 0.001	-
TMSC-$Mg(OH)_2$ coated, aged	87.1 ± 0.1	1.8 ± 0.02	12.5 ± 0.01	12.9 ± 0.1	72.9 ± 0. 1	4 ± 0.02	24.3 ± 0.001	10 ± 0.1

Table S3. Elemental composition of uncoated and coated filter paper, obtained from EDX analysis. The values were obtained from the average of six independent measurements from two samples.

Samples	Filter paper						
	C (at. %)	O (at. %)	Al (at. %)	K (at. %)	S (at. %)	Mg (at. %)	Si (at. %)
Uncoated	55.4 ± 0.5	44.5±0.3	n.d	n.d	n.d	n.d	n.d
TMSC coated	52.1 ± 0.2	44.9 ± 0.6	n.d	n.d	n.d	n.d	2.9 ± 0.2
TMSC coated, aged	55.8 ± 0.3	43.8 ± 1.2	n.d	n.d	n.d	n.d	n.d
TMSC-$Mg(OH)_2$ NPs coated	50.1 ± 1.1	29.9 ± 0.4	n.d	n.d	n.d	11.8 ± 0.4	7.9 ±0.3
TMSC-$Mg(OH)_2$ NPs coated, aged	54.2 ± 0.5	28.2± 1.2	n.d	n.d	n.d	10.8 ± 0.5	6.5 ± 1.0

Table S4. Elemental composition of uncoated and coated HWP paper, obtained from EDX analysis. The values were obtained from the average of six independent measurements from two samples.

Samples	HWP paper						
	C (at. %)	O (at. %)	Al (at. %)	K (at. %)	S (at. %)	Mg (at. %)	Si (at. %)
Uncoated	51.2± 0.1	44.5 ± 0.2	1.5± 0.3	1.2 ± 0.2	1.3 ± 0.7	n.d	n.d
TMSC coated	49.8 ± 0.2	42.8 ± 0.4	0.9 ± 0.5	0.8 ± 0.5	0.8 ± 0.5	n.d	4.8 ± 0.5
TMSC coated, aged	52.2 ± 0.4	44.2 ± 0.5	1.1 ± 0.3	1.1 ± 0.3	0.9 ± 0.3	n.d	n.d
TMSC-$Mg(OH)_2$ NPs coated	38.1 ± 0.5	25.1 ± 0.1	0.8 ± 0.1	0.8 ± 0.1	0.8 ± 0.1	23.2 ± 1.0	11.2 ± 0.3
TMSC-$Mg(OH)_2$ NPs coated, aged	41.3 ± 0.4	26.1 ± 0.5	0.9 ± 0.1	0.9 ± 0.2	0.8 ± 0.2	18.2 ±1.0	10.8 ±0.9

Table S5. Alkaline reserve (AR in meq[OH^-]/100g of paper)) and pH of coated paper before and after aging. A particle concentration of 0.0625 and 0.25 % (w/v) were used for coating of filter and HWP paper.

Samples	Filter paper			HWP paper		
	pH	AR	$Mg(OH)_2$ (wt.%)	pH	AR	$Mg(OH)_2$ (wt.%)
TMSC-$Mg(OH)_2$ coated	7.5 ± 0.1	3.8 ± 0.1	0.1	7.6 ± 0.3	9.1 ± 0.1	0.3
TMSC-$Mg(OH)_2$ coated, aged	7.2 ± 0.3	3.7 ± 0.2	0.1	6.6 ± 0.1	7.1 ± 0.2	0.2

Table S6. Young modulus (MPa) of coated and uncoated papers before and after aging.

	Filter paper	HWP paper
Uncoated	1920 ± 93	1780 ± 92
Uncoated, aged	1700 ± 38	1780 ± 88
TMSC coated	2130 ± 70	2160 ± 98
TMSC coated, aged	1530 ± 111	2080 ± 345
TMSC-$Mg(OH)_2$ NPs coated	1010 ± 117	1490 ± 104
TMSC-$Mg(OH)_2$ NPs coated, aged	953 ± 157	1370 ± 270