

## Supplementary Materials

# The Effect of Temperature Cycling on the Magnetic Degradation and Microstructure of a Zn-Coated NdFeB Magnet

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**Table S1.** Temperature dependence of the  $\Phi$ ,  $B$  and their losses of the sample from R.T. to 300 °C.

Temperature / °C	$\Phi$ / mWb	Loss of $\Phi$ / %	$B$ / mT	Loss of $B$ / %
Original sample	20.38	0.00	191	0.00
80	20.15	1.08	191	0.21
120	20.10	1.33	190	0.73
150	20.06	1.52	188	1.78
180	19.57	3.93	155	19.02
220	9.37	54.00	60	68.65
250	3.88	80.95	23	87.98
300	0.21	98.97	1	99.48

**Table S2.** The  $\Phi$ ,  $B$  and their losses of samples were cycled different times in the range of R.T. — 180 °C and -50 °C — 180 °C, respectively.

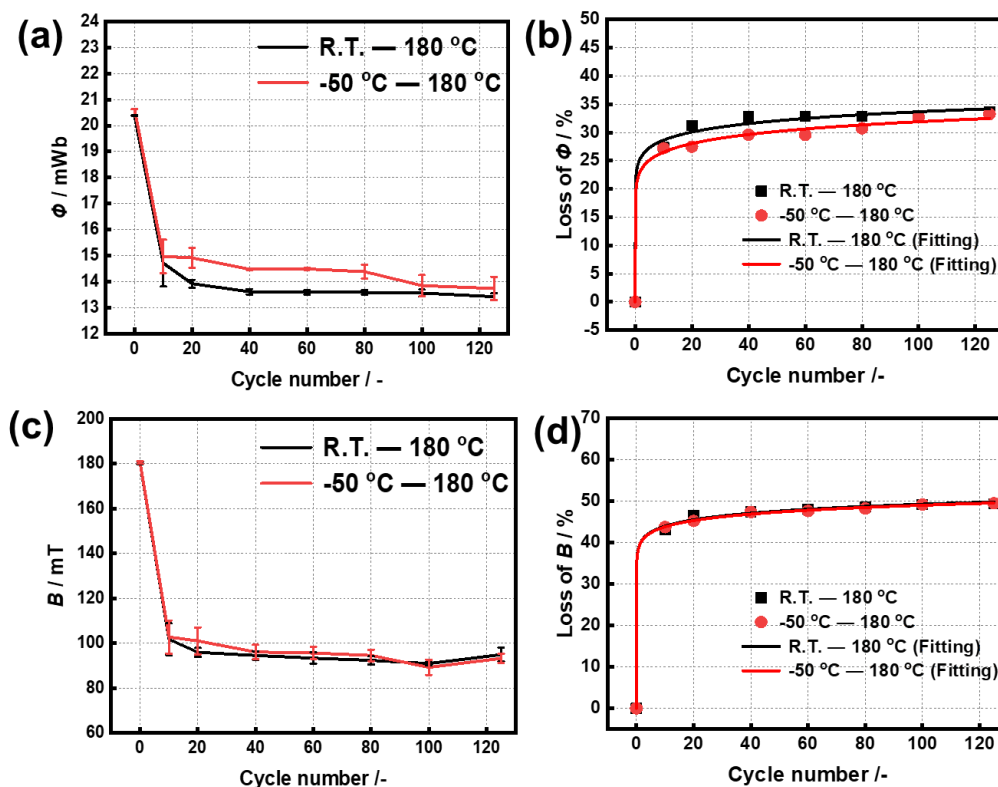
Temperature range	Cycle Number	$\Phi$ / mWb	Loss of $\Phi$ / %	$B$ / mT	Loss of $B$ / %
R.T.–180 °C	0	20.38	0.00	180	0.00
	10	14.71	27.39	102	43.11
	20	13.92	31.24	96	46.69
	40	13.61	32.77	95	47.48
	60	13.60	32.87	93	48.13
	80	13.59	32.87	92	48.69
	100	13.56	33.02	91	49.24
	125	13.42	33.71	91	49.44
-50–180 °C	0	20.36	0.00	182	0.00
	10	14.72	27.24	103	43.78
	20	14.67	27.48	100	45.28
	40	14.24	29.61	96	47.42
	60	14.25	29.56	95	47.68
	80	14.01	30.75	94	48.26
	100	13.61	32.72	93	49.21
	125	13.50	33.27	92	49.73

**Table S3.** Values of fitting parameter and their standard errors (*S.E.*) in the range of R.T.—180 °C and -50—180 °C, respectively. The fitting formulae is given by  $Y = A \times (X - X_c)^P$ .

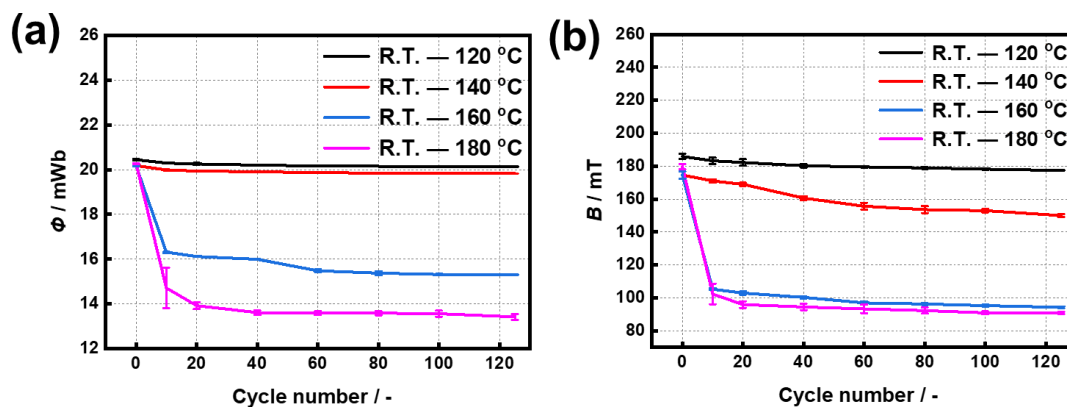
Y	Temperature Range	Fitting Parameter						
		$X_c$	$S.E. (X_c)$	$A$	$S.E. (A)$	$P$	$S.E. (P)$	$R^2$
Loss of $\Phi$	R.T.—180 °C	0.00	18.47	24.37	5.28	0.07	0.05	0.99
	-50—180 °C	0.00	14.27	22.05	4.20	0.08	0.04	0.99
Loss of $B$	R.T.—180 °C	0.00	12.85	39.30	4.19	0.05	0.02	0.99
	-50—180 °C	0.00	6.80	39.21	2.21	0.05	0.01	0.99

**Table S4.** The  $\Phi$ ,  $B$  and their losses of the samples were cycled different times in the range of R.T. to 120, 140, and 160 °C, respectively.

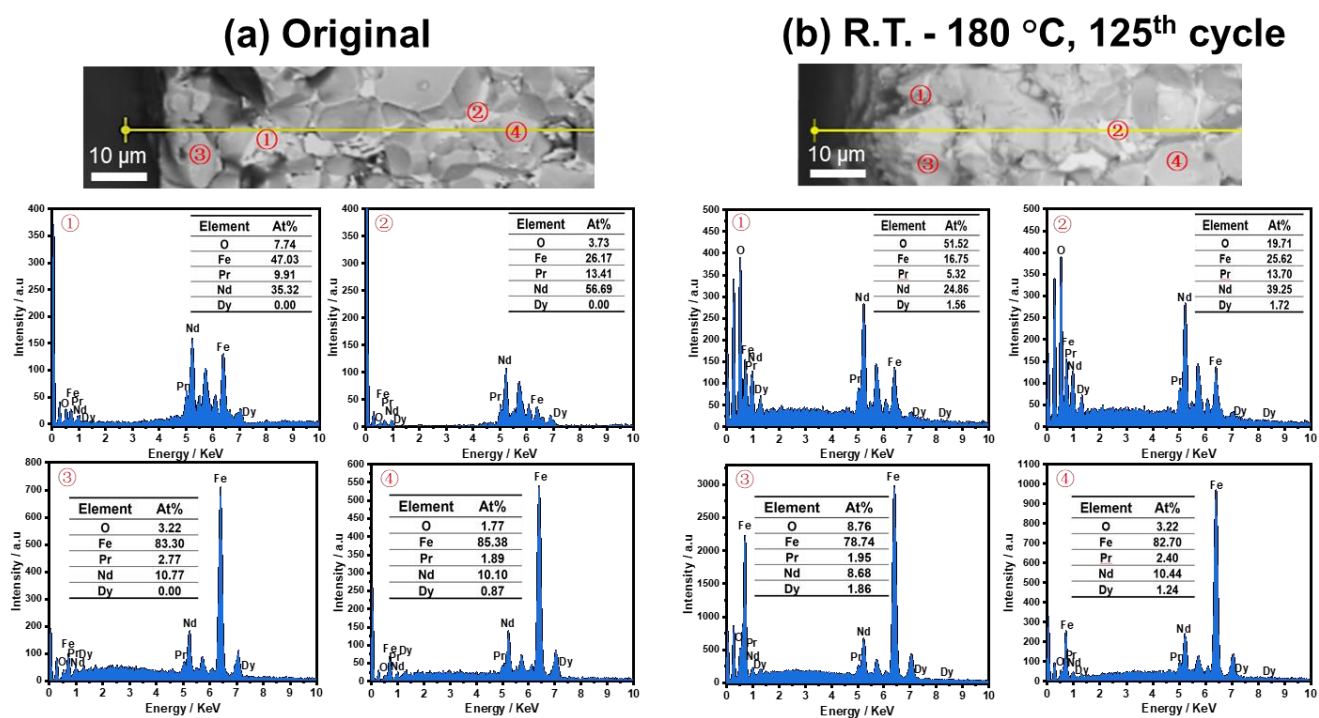
Temperature Range	Cycle Number	$\Phi$ / mWb	Loss of $\Phi$ /%	$B$ / mT	Loss of $B$ /%
R.T.—120 °C	0	20.19	0.00	187	0.00
	10	20.04	0.76	183	1.88
	20	20.00	0.94	182	2.41
	40	19.95	1.21	180	3.49
	60	19.91	1.40	180	3.66
	80	19.90	1.45	179	4.20
	100	19.89	1.50	178	4.56
	125	19.87	1.58	177	5.02
R.T.—140 °C	0	20.18	0.00	175	0.00
	10	19.98	0.97	171	2.10
	20	19.94	1.21	169	3.25
	40	19.90	1.37	161	8.02
	60	19.86	1.59	156	10.88
	80	19.84	1.67	154	12.02
	100	19.83	1.75	153	12.41
	125	19.82	1.78	150	14.12
R.T.—160 °C	0	20.16	0.00	175	0.00
	10	16.31	19.13	105	39.70
	20	16.12	20.05	103	41.03
	40	15.99	20.68	100	42.56
	60	15.48	23.23	97	44.47
	80	15.37	23.75	96	44.85
	100	15.32	24.04	95	45.42
	125	15.30	24.10	94	46.18



**Figure S1.** (a)  $\Phi$  and (b) its loss, (c)  $B$  and (d) its loss of the samples cycled in ranges of R.T. — 180 °C and -50 — 180 °C, respectively. The straight lines in (a) and (c) connect the data points. The lines in (b) and (d) are the fitting curves, and the fitting formula is given by  $Y = A \times (X - X_c)^p$ .



**Figure S2.** The (a)  $\Phi$  and (b)  $B$  of the samples cycled in ranges of R.T. to 120, 140, 160, and 180 °C, respectively.



**Figure S3.** Cross-sectional backscattered SEM micrographs and EDS point elemental analysis from the surface to the inner of the different NdFeB magnets. (a) original sample; (b) sample after 125 cycles in range of R.T.–180 °C.