Enhanced electromechanical response in Dy^{3+} doped PNN-PZT relaxor ferroelectrics

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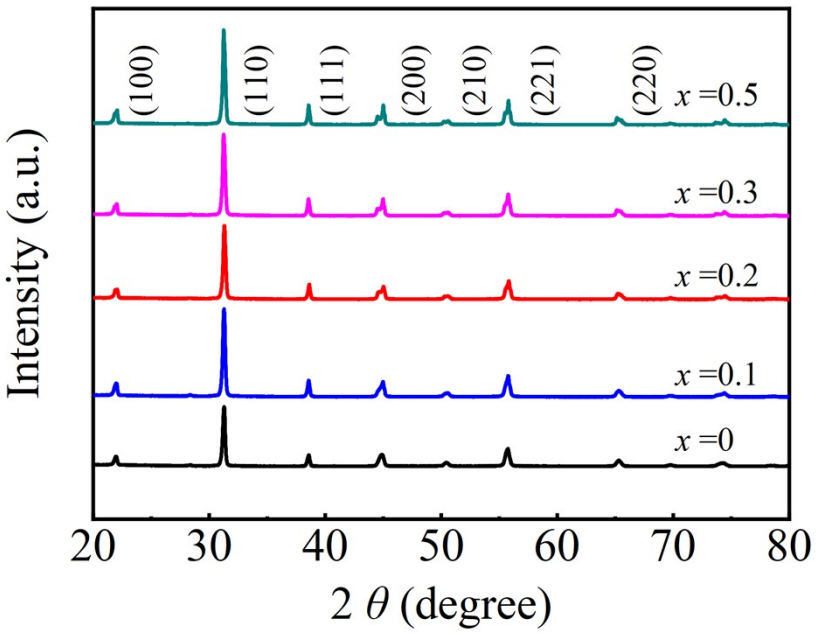

Figure S1 XRD patterns of PNN-PZT-PMW-*x*Dy ceramics as a function of Dy_2O_3 content, $2\theta = 20° - 80°$.

Table S1 Parameters of crystal structure of the PNN-PZT-PMW-*x*Dy.

x content	R phase				T phase				
	a (Å)	b (Å)	c (Å)	V (Å³)	a (Å)	b (Å)	c (Å)	c/a	V (Å³)
0	5.718	5.718	14.028	397.259	4.026	4.026	4.059	1.008	65.841
0.2	5.716	5.716	14.040	397.227	4.025	4.025	4.064	1.010	65.791
0.5	5.677	5.677	13.860	386.831	4.026	4.026	4.064	1.009	65.889

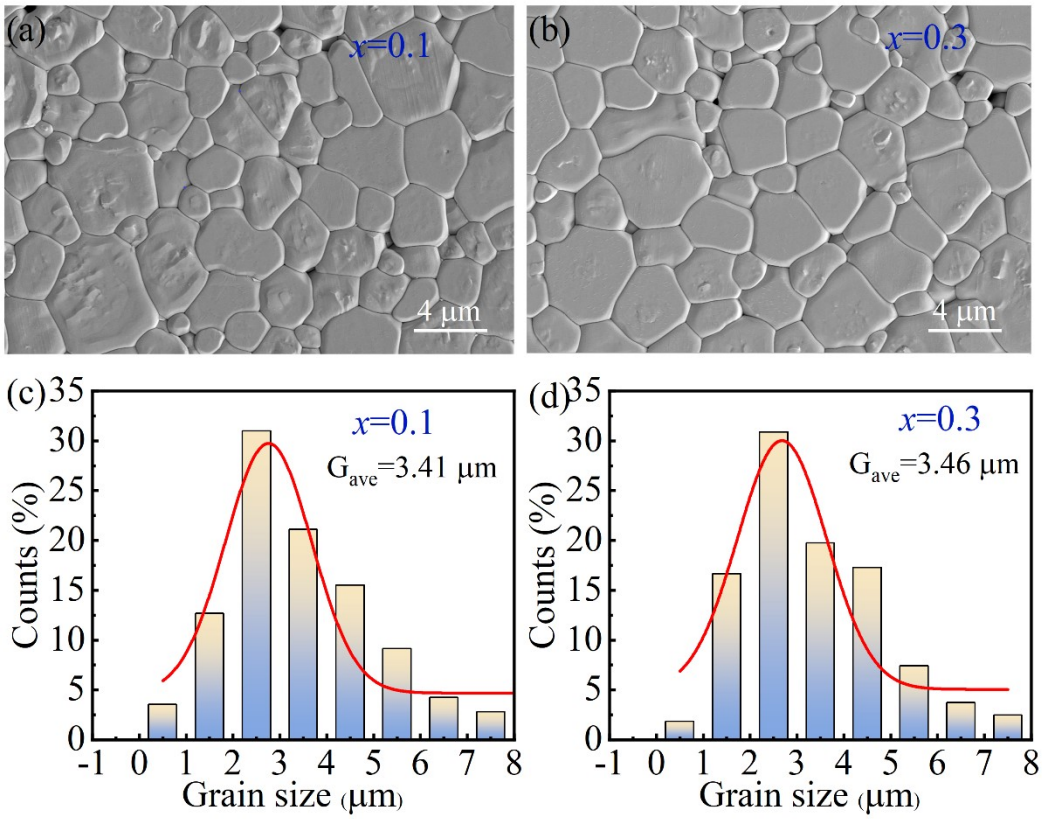

Figure S2 The surface microstructure and grain size distribution for the PNN-PZT-PMW-*x*Dy ceramics with (a, c) x = 0.1, (b, d) x = 0.3. The insets of (c,d) denote the average grain size.

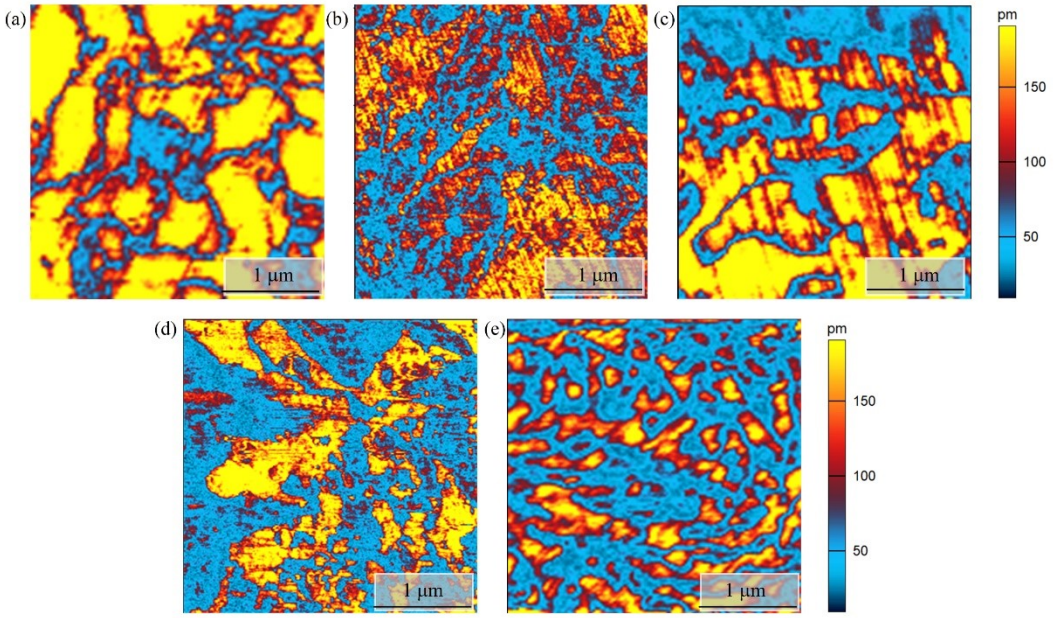

Figure S3 The amplitude images for the PNN-PZT-PMW-*x*Dy ceramics with (a) $x = 0$, (b) $x = 0.1$, (c) $x = 0.2$, (d) $x = 0.3$, and (e) $x = 0.5$.

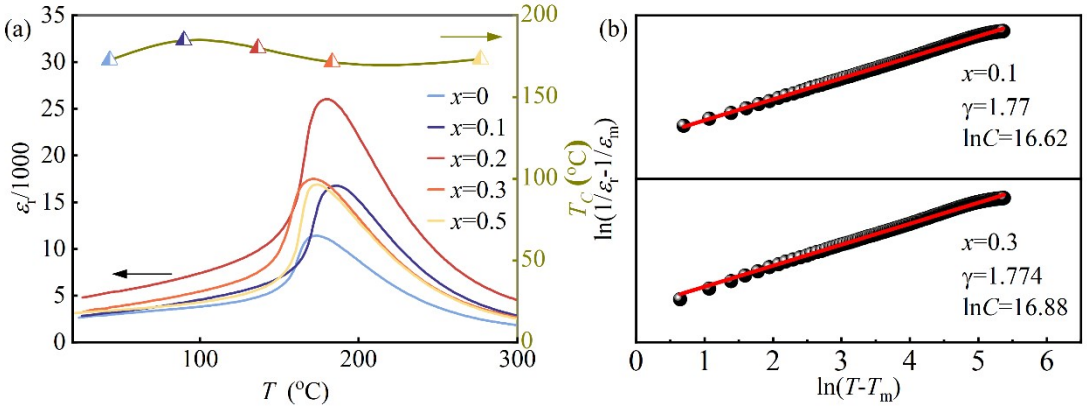

Figure S4 (a) Dy_2O_3 content dependence of unpoled PNN-PZT-PMW-*x*Dy ceramics and the temperature dependence of dielectric constant (ε_r) for $x = 0$, 0.1, 0.2,0.3 and 0.5, measured at $f = 1$ kHz. (b) Plots of ln $(1/\varepsilon_r - 1/\varepsilon_m)$ versus ln $(T-T_m)$ for $x = 0.1$ and 0.3.

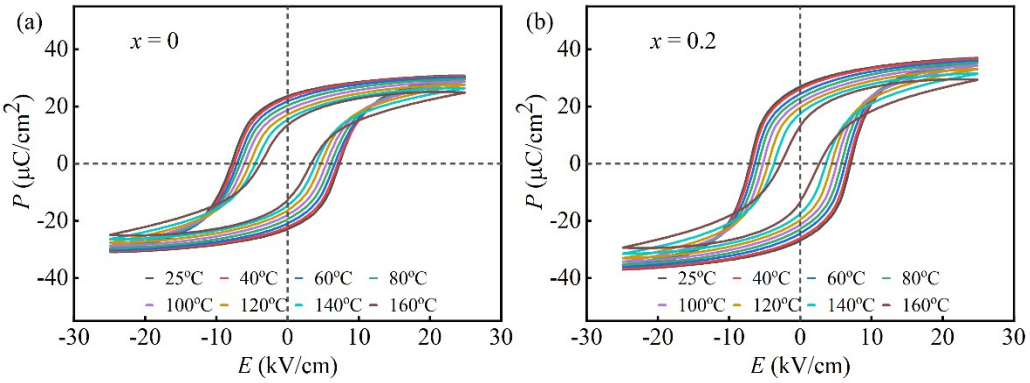

Figure S5 The temperature-dependent P-E curves of PNN-PZT-PMW-*x*Dy ceramics for (a) *x*=0, and (b) *x*=0.2.