Electronic supplementary information (ESI†)

Significantly enhanced mechanoluminescence from Nb^{5+} co-doped $ZrO_2:Sm^{3+}$ via high valence ion doping strategy

Jia Tong,[a] *Jun Huan,* [a] *Xin Yu ,* [a] *Jia-Hui Cheng,* [a] *Zhi-Jun Zhang,* [a] *Juan-Juan Xing,* [a] *Jing-Tai Zhao,* [b] *Xin-Xin Yang,* [a,*]

[a] School of Materials Science and Engineering, Shanghai University, Shanghai, 200072, P.R. China
[b] School of Materials Science and Engineering, Guilin University of Technology, Guilin, 541000, P. R. China
E-mail: yangxinxin@t.shu.edu.cn

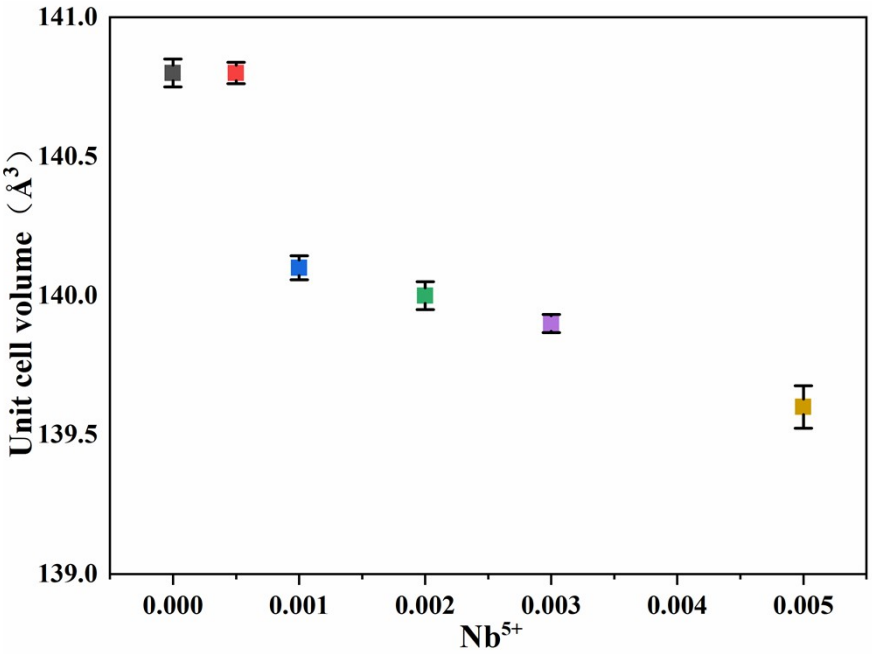

Fig. S1. The relationship between the unit cell volumes of the ZrO_2:Sm^{3+}, Nb^{5+} phosphors and Nb^{5+} concentration.

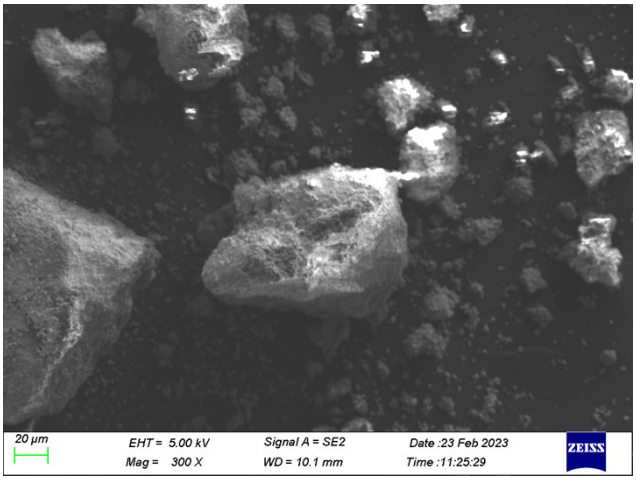

Fig. S2. SEM images of ZrO_2:Sm^{3+},0.003Nb^{5+}

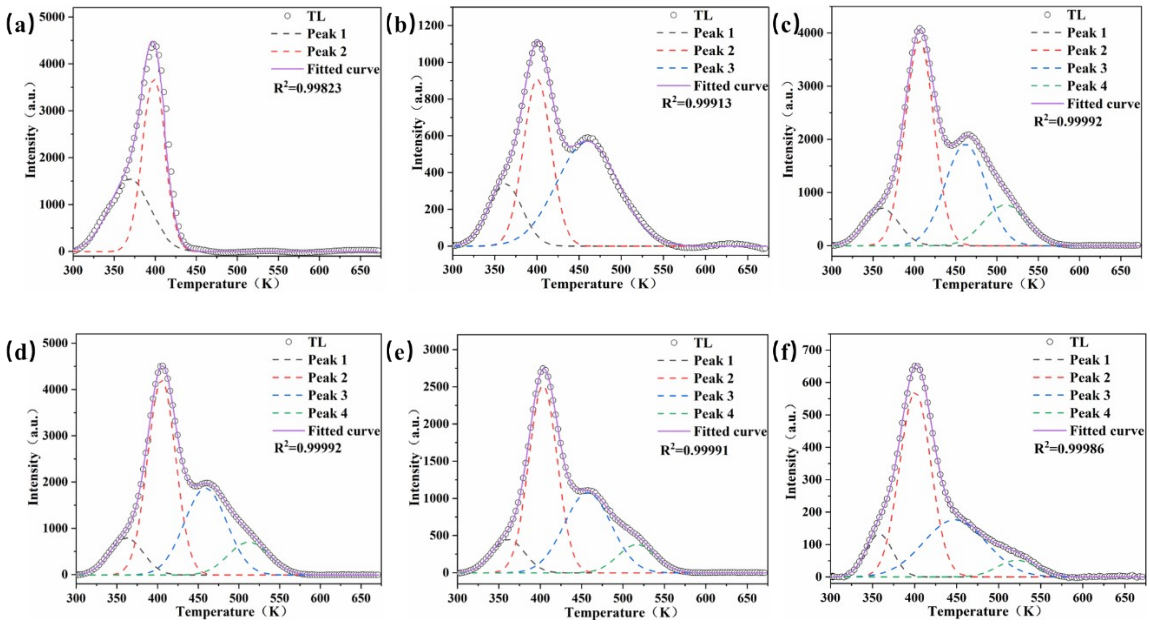

Fig. S3 (a)TL curves and the fitting curves of ZrO_2 phosphors; (b) TL curves and the fitting curves of ZrO_2:Sm^{3+} phosphors; (c) TL curves and the fitting curves of ZrO_2:Sm^{3+},0.0005Nb^{5+}phosphors; (d) TL curves and the fitting curves of ZrO_2:Sm^{3+},0.001Nb^{5+}phosphors; (e) TL curves and the fitting curves of ZrO_2:Sm^{3+},0.002Nb^{5+}phosphors; (f) TL curves and the fitting curves of ZrO_2:Sm^{3+},0.005Nb^{5+}phosphors;

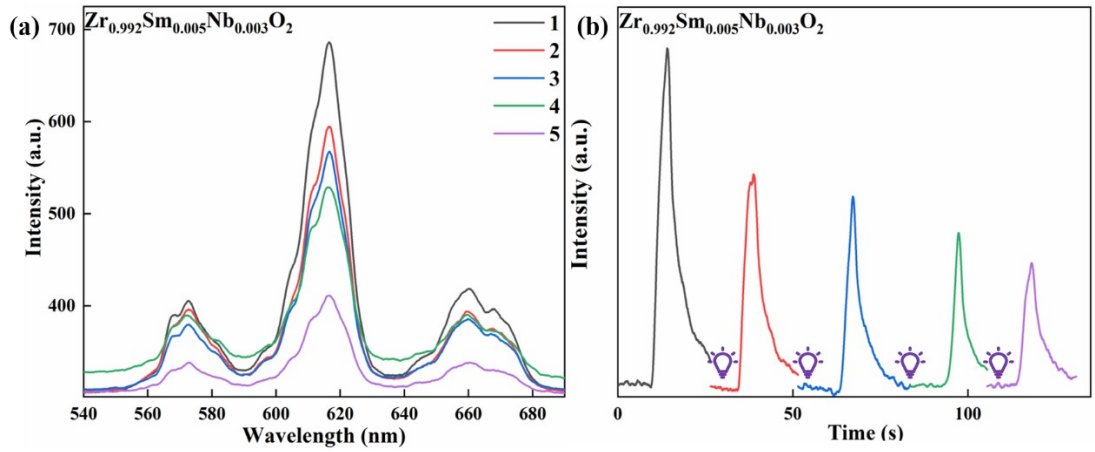

Fig. S4 ML recovery behavior under UV irradiation 3 min. (a) ML spectra under 5 times UV irradiation-load cycles. (b) ML reproducibility during 5 load cycles after UV irradiation in each cycle.

Table. S1. The fitting results of different samples

	ZrO_2	ZrO_2: 0.005Sm	ZrO_2: 0.005Sm, 0.0005Nb	ZrO_2: 0.005Sm, 0.001Nb	ZrO_2: 0.005Sm, 0.002Nb	ZrO_2: 0.005Sm, 0.003Nb	ZrO_2: 0.005Sm, 0.005Nb
Trap1	0.77	0.73	0.72	0.72	0.72	0.71	0.72
Trap2	0.83	0.80	0.81	0.81	0.81	0.81	0.81

Trap3	-	0.92	0.92	0.92	0.91	0.92	0.90
Trap4	-	-	1.02	1.02	1.03	1.03	1.04
R^2	0.99823	0.99913	0.99992	0.99992	0.99991	0.99971	0.99986