

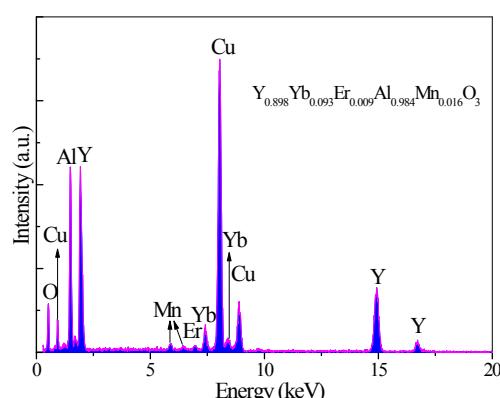
## Electronic supplementary information (ESI)

# **Ln<sup>3+</sup>-Sensitized Mn<sup>4+</sup> Near-Infrared Upconverting Luminescence and Dual-Modal Temperature Sensing**

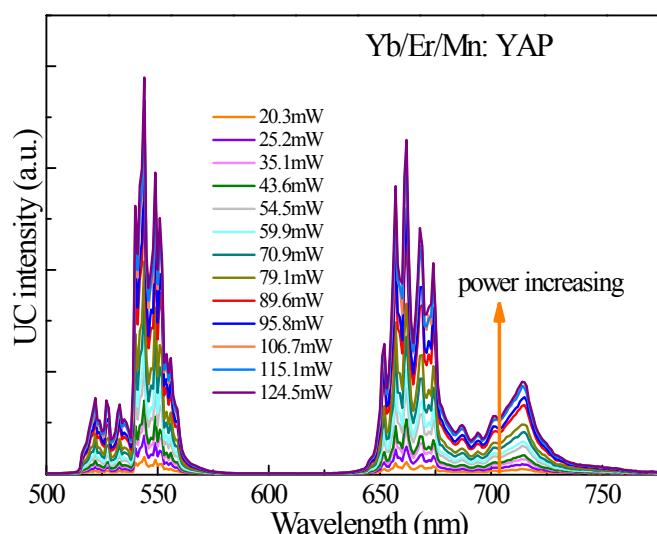
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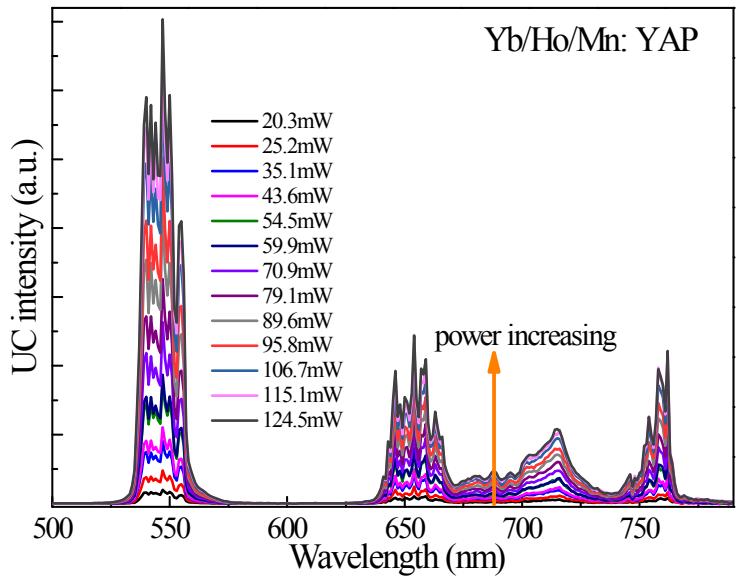
\*Corresponding Author: E-Mail: dqchen@hdu.edu.cn (D. Q. Chen)



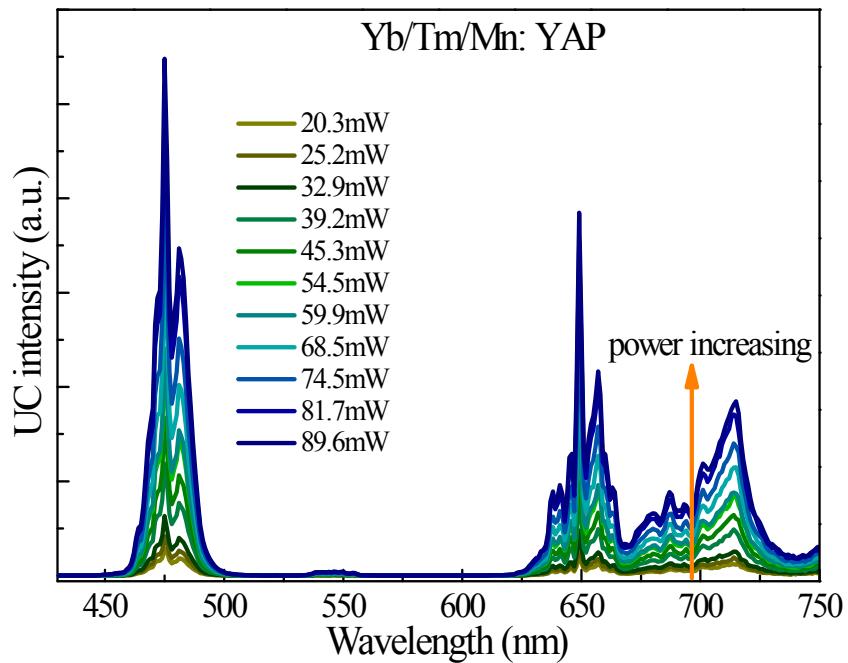
**Figure S1** EDS spectrum of a typical Yb/Er/Mn (10/1/1 mol%): YAP sample.



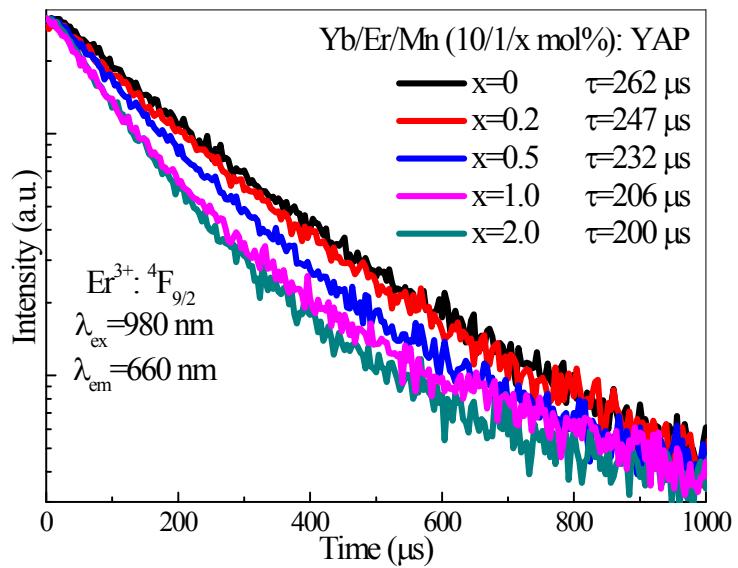
**Figure S2** Pumping-power-dependent UC emission spectra for Yb/Er/Mn: YAP sample under 980 nm NIR laser excitation.



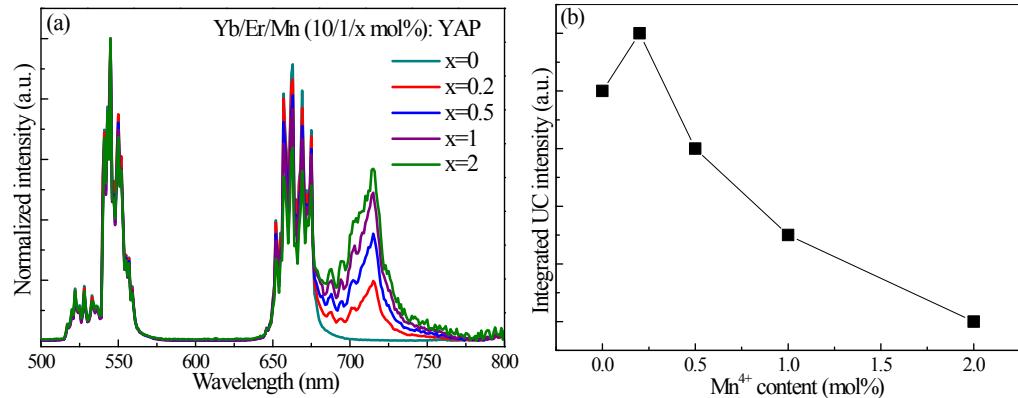
**Figure S3** Pumping-power-dependent UC emission spectra for Yb/Ho/Mn: YAP sample under 980 nm NIR laser excitation.



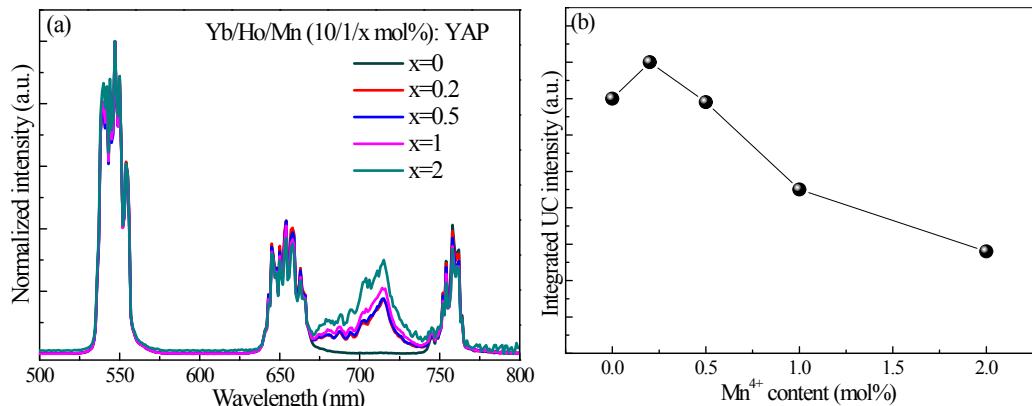
**Figure S4** Pumping-power-dependent UC emission spectra for Yb/Tm/Mn: YAP sample under 980 nm NIR laser excitation.



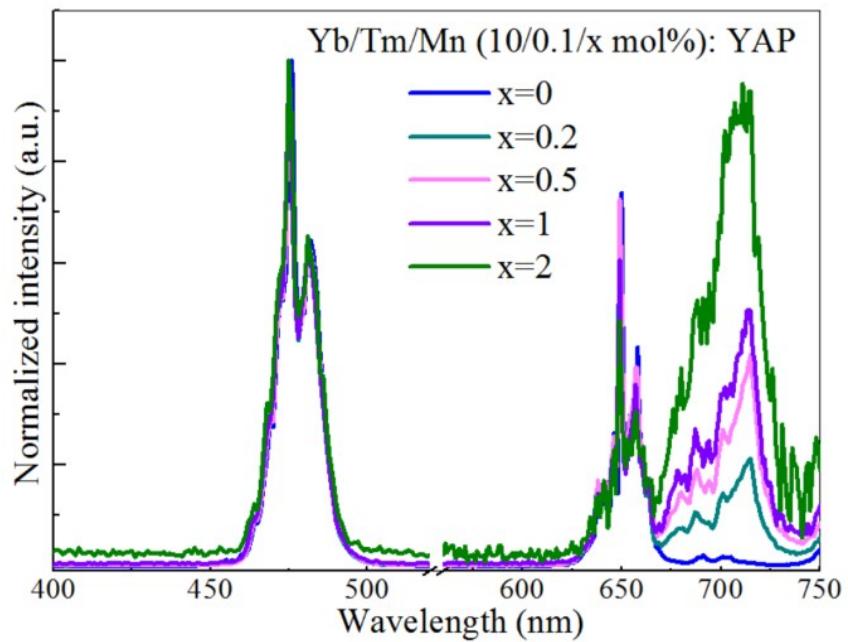
**Figure S5** Mn<sup>4+</sup>-content-dependent UC decay curves of  $\text{Er}^{3+}: 4\text{F}_{9/2}$  emitting state in the Yb/Er/Mn: YAP sample under 980 nm laser excitation.



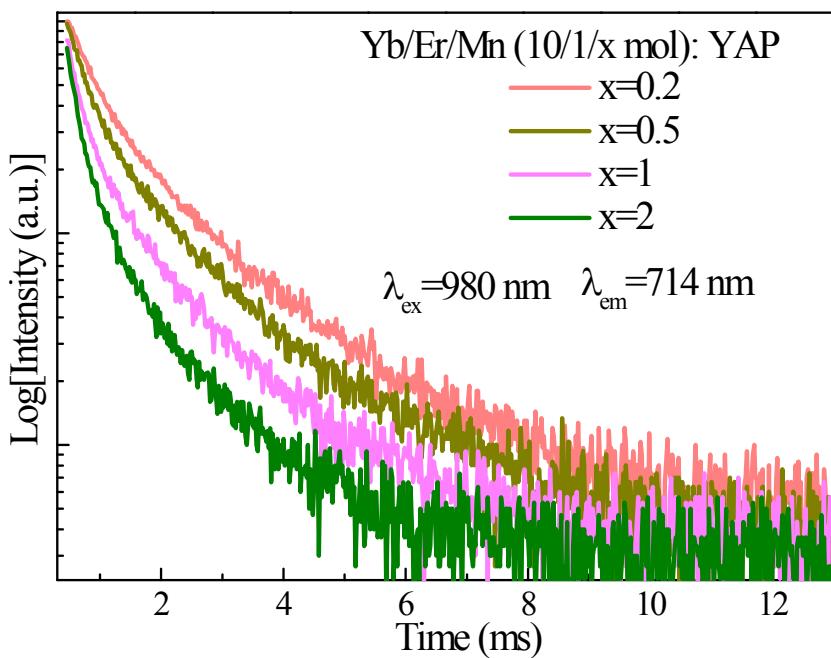
**Figure S6** Mn<sup>4+</sup>-content-dependent (a) normalized UC emission spectra and (b) integrated emission intensity for the Yb/Er/Mn: YAP sample under 980 nm laser excitation.



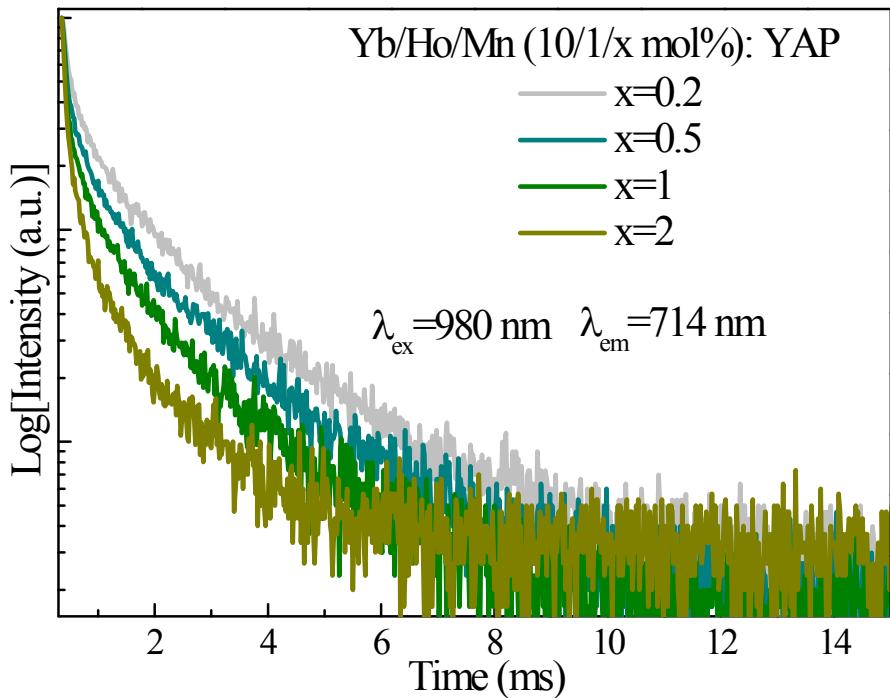
**Figure S7** Mn<sup>4+</sup>-content-dependent (a) normalized UC emission spectra and (b) integrated emission intensity for the Yb/Ho/Mn: YAP sample under 980 nm laser excitation.



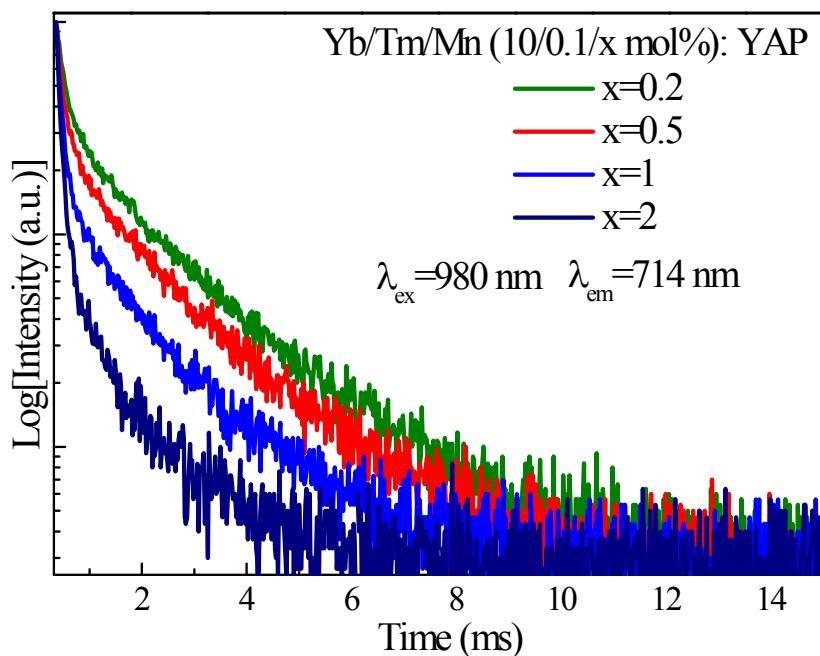
**Figure S8** Mn<sup>4+</sup>-content-dependent normalized UC emission spectra in the Yb/Tm/Mn: YAP sample under 980 nm laser excitation.



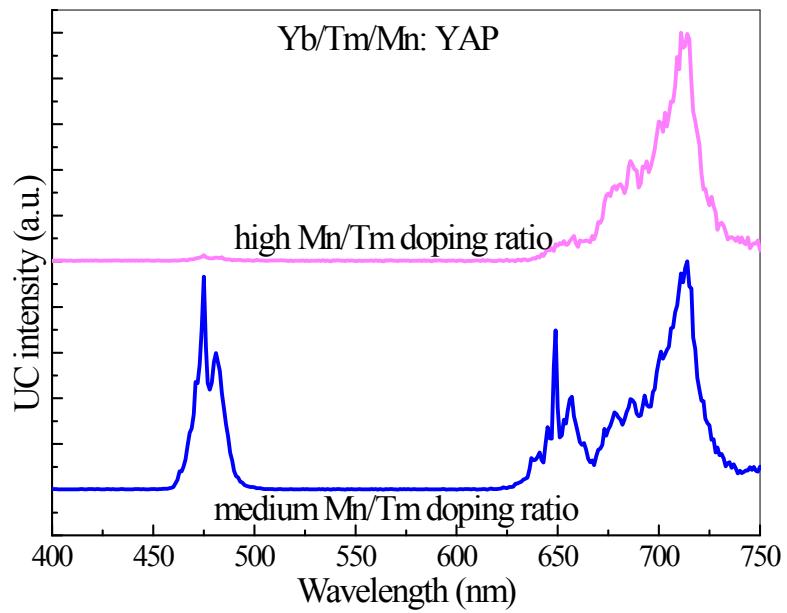
**Figure S9** Mn<sup>4+</sup>-content-dependent UC decay curves of Mn<sup>4+</sup>: <sup>2</sup>E emitting state in the Yb/Er/Mn: YAP sample under 980 nm laser excitation.



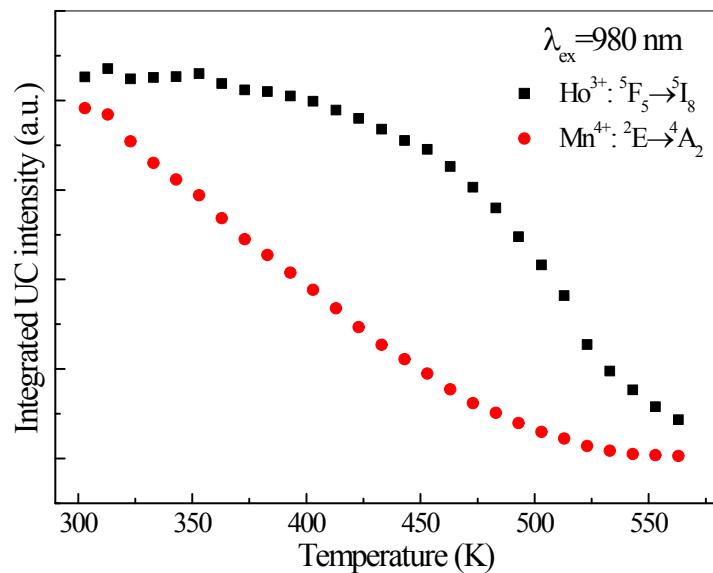
**Figure S10**  $\text{Mn}^{4+}$ -content-dependent UC decay curves of  $\text{Mn}^{4+}: {}^2\text{E}$  emitting state in the Yb/Ho/Mn: YAP sample under 980 nm laser excitation.



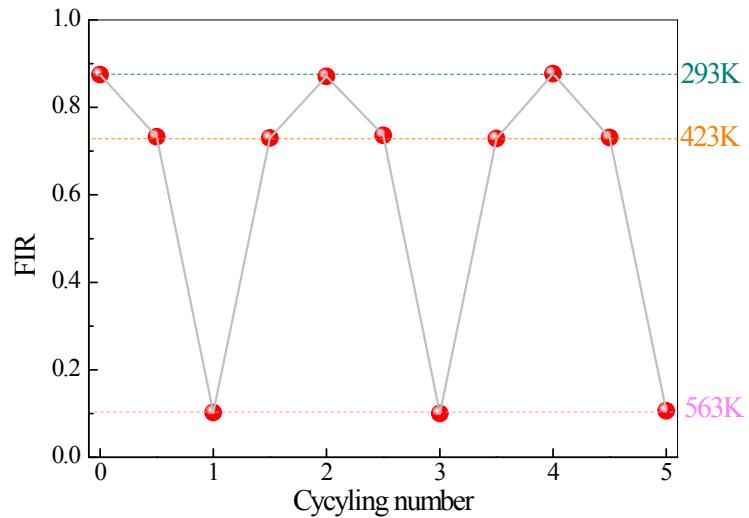
**Figure S11**  $\text{Mn}^{4+}$ -content-dependent UC decay curves of  $\text{Mn}^{4+}: {}^2\text{E}$  emitting state in the Yb/Tm/Mn: YAP sample under 980 nm laser excitation.



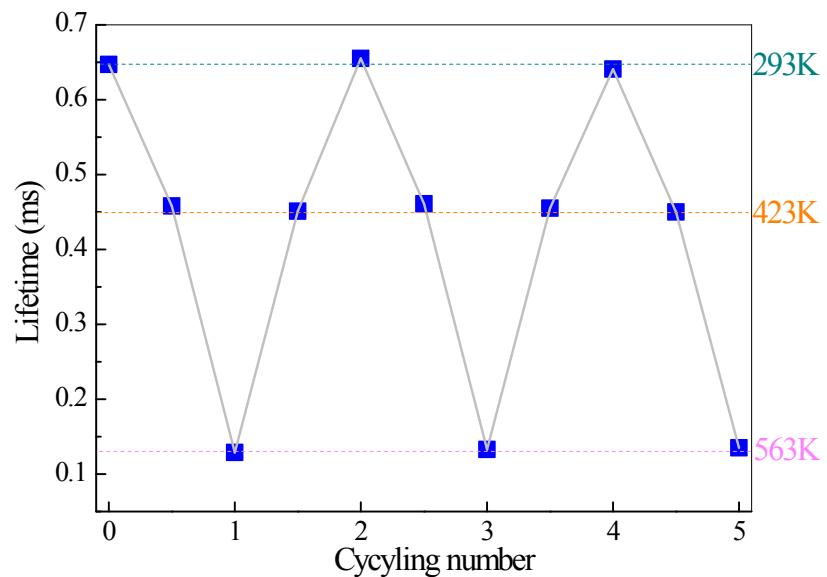
**Figure S12** Comparison of UC emission spectra for the Yb/Tm/Mn: YAP samples with different Mn/Tm doping ratios.



**Figure S13** Temperature-dependent integrated UC emission intensities of  $\text{Ho}^{3+}$  and  $\text{Mn}^{4+}$  in the Yb/Ho/Mn: YAP sample.



**Figure 14** Switching of UC FIR value induced by alternating temperature between 293K and 563K.



**Figure 15** Switching of UC lifetime value induced by alternating temperature between 293K and 563K.