Support Information

Enhanced plasmonic photothermal effect for crystal transformation by heat-trapping structure

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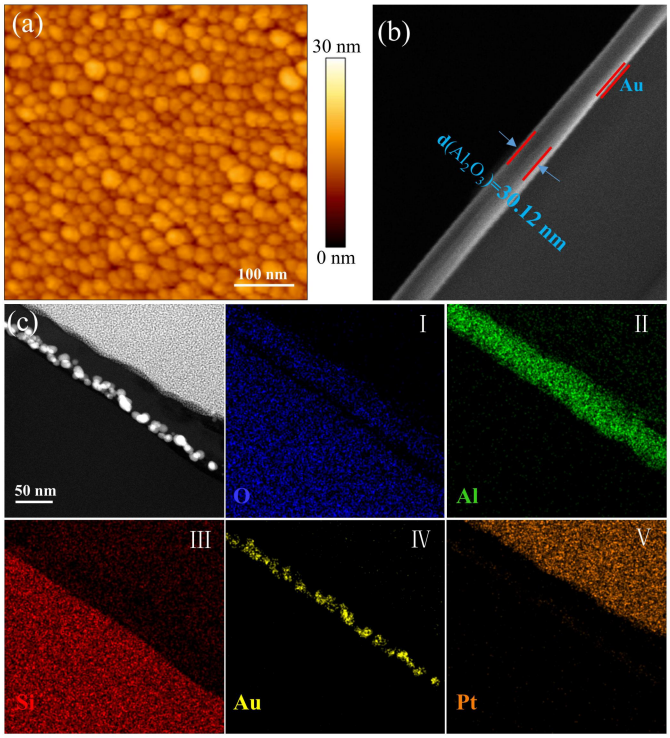

Fig. S1 (a) AFM image of AuNIs annealed at 300 ℃, the average size of the nanoparticles is about 10 nm and the average roughness values is 1.47 nm; (b) SEM image of a cross-section of heat-trapping structure, it shows that the thickness of Al_2O_3 is 30 nm; (c) HAADF-STEM image and EDX elemental mapping of the cutted cross-section heat-trapping structure, the substrate is

Si/SiO_2 and the Pt served as a protective layer is introduced to the structure during cutting the sample.

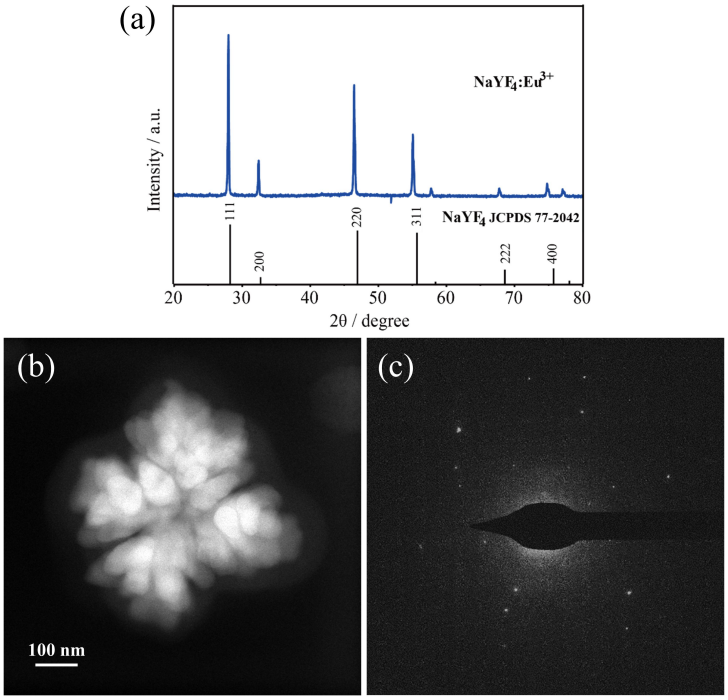

Fig. S2 (a) XRD pattern of as-synthesized $NaYF_4:Eu^{3+}$ sub-microcrystal and the standard pattern of cubic phase $NaYF_4$ (JCPDS No.77-2042); (b) HAADF-STEM image and (c) SAED pattern of $NaYF_4:Eu^{3+}$ sub-microcrystal, respectively. The results indicate that $NaYF_4$ is polycrystalline.

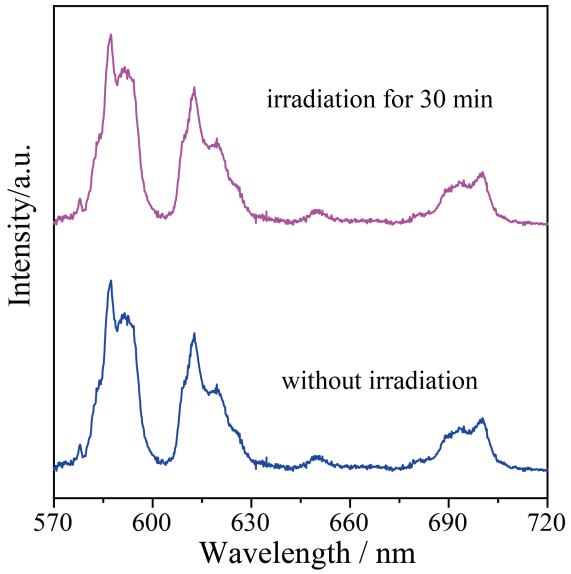

Fig. S3 Luminescence spectra of $NaYF_4:Eu^{3+}$ on glass substrate without AuNIs before and after laser irradiation (30 min) by heat trapping layer of Al_2O_3. No changes are observed in the

luminescence spectra for glass substrate with Al_2O_3 even after laser irradiation for 30 min, which indicates the plasmonic AuNIs plays an important role in crystal transformation.

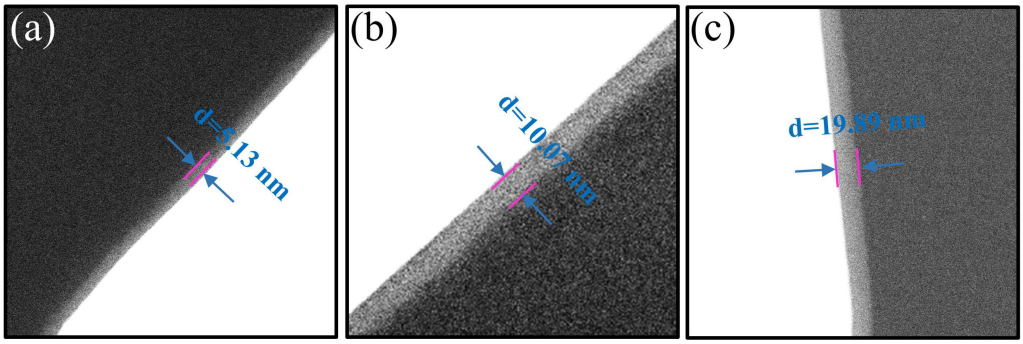

Fig. S4 (a-c) HAADF-STEM images of cross-section of heat-trapping structure, the thickness of Al_2O_3 is 5 nm, 10 nm and 20 nm, respectively. It is almost consistent with the set values about the thickness of Al_2O_3.

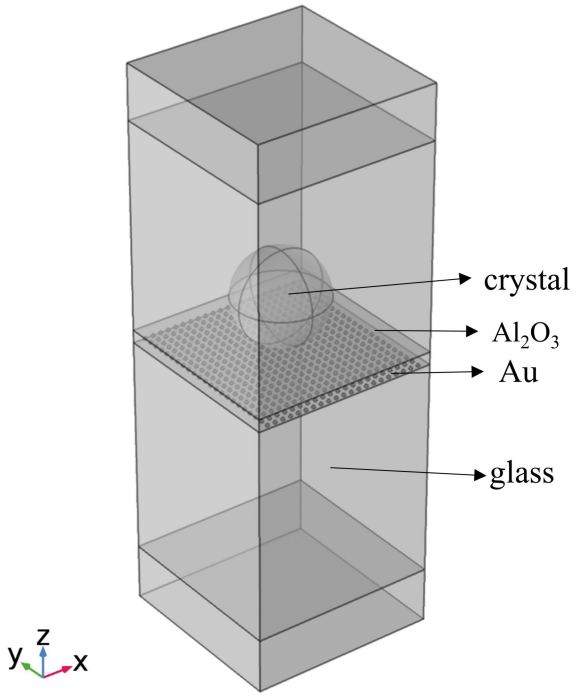

Fig. S5 The simulation model of heat-trapping structure. The AuNIs is built as Au NPs array with a diameter of 20 nm and the crystal is approximately built as a sphere with a diameter of 500 nm. The thickness of Al_2O_3 is 50 nm. The glass layer at the bottom of the model is under the Au NPs, and the Al_2O_3 layer is above the Au NPs. The crystal is placed on the top of Al_2O_3 layer. In order

to clarify the heat transfer mechanism of heat-trapping structure more clearly, only the Au NPs arrarys are shown in the Fig.5a.

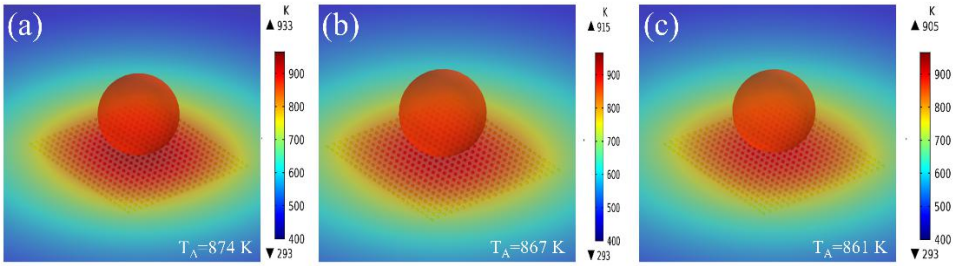

Fig. S6. (a-c) The temperature distributions of heat-trapping structure with Al_2O_3 layer thickness of 30, 40 and 50 nm, respectively. T_A is the average temperature of the crystal and the symbols "▲" in the scale bar represents the maximum temperature of the whole system. The average temperatures of crystal are stable at around 870 K when the thickness of Al_2O_3 is 30-50 nm. Such a slight change in the temperature of crystal is not sufficient to affect the crystal transformation time. Therefore, the transformation time will not change for the thickness of Al_2O_3 from 30 to 50 nm in experiments and simulations.

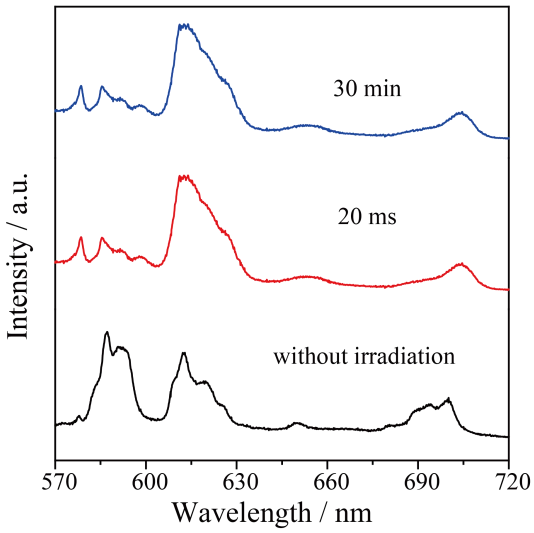

Fig. S7 *In-situ* luminescence spectra with and without laser irradiation of $NaYF_4:Eu^{3+}$ sub-microcrystal on AuNIs with dielectric layer of SiO_2 substrate (50 nm).

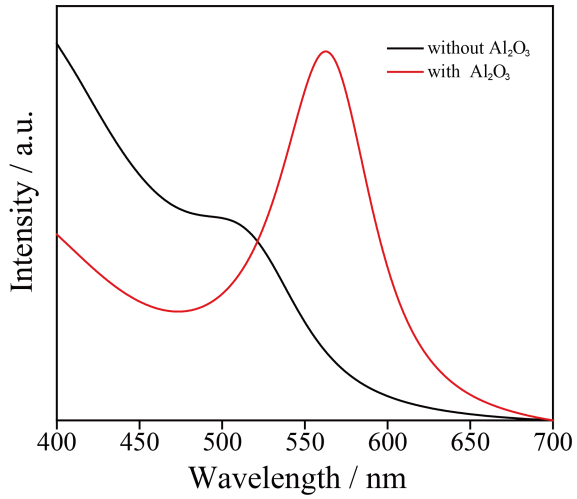

Fig. S8 Simulation of normalized absorption spectra of AuNIs with and without heat-trapping layer of Al_2O_3. It is obviously seen that the LSPR peak is red-shifted and the light absorption is greatly improved by assistance of Al_2O_3.