Supporting information

Tailored Molecular Engineering of Mesoporous Silica for High Concentration Er Doping and Unconventional 1640 nm Luminescence

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Instrumentation

XRD spectra were recorded using a BRUKER D8 Advanced with operating voltage and current set to 35 kV and 35 mA, respectively. HRTEM images were recorded using a JEOL 2100 Plus operating at 200 kV, where the sample was sputtered onto a 300 mesh Cu grid by dispersing it into ethanol. Surface morphology and textural properties, including BET surface area and pore size distribution, were analyzed using an Autosorb iQ, Maker: Quantachrome instrument. Nitrogen adsorption–desorption isotherms were recorded at 77 K. X-ray photoelectron spectroscopy (XPS) spectrum (for individual elements and wide range spectrum) was recorded using PHI 5000 Versa Probe II FEI Inc. spectrometer using Al K radiation (1486.6 eV). For XPS the powder sample was fixed on the sample holder and kept under ultra-high vacuum conditions for 48 h. The obtained XPS data was deconvoluted and fitted for characteristic peaks using Origin Pro 2021b software with the help of existing literature reports. All XPS spectra were calibrated concerning the C 1s peak (BE 284.8 eV). Elemental mapping and quantitative compositional analysis were carried out using Electron Probe Micro Analyzer Model: JXA-8230 Manufacturer: JEOL Ltd., Japan. UV-Vis-NIR absorption spectra were collected using a Shimadzu UV-3600 spectrophotometer. Photoluminescence (PL) spectra were recorded using FLS1000 Photoluminescence Spectrometer equipped with a 980 nm laser diode as the excitation source.

Sample identification	**Er Concentration of solid phase extraction (ppm)**	**Wt% of Er**
Er-400-HT	400	6.71
Er-800-HT	800	5.21
Er-1600-HT	1600	3.78

Table S1 EPMA results for the weight percent (wt%) of Er in various Er-doped samples.

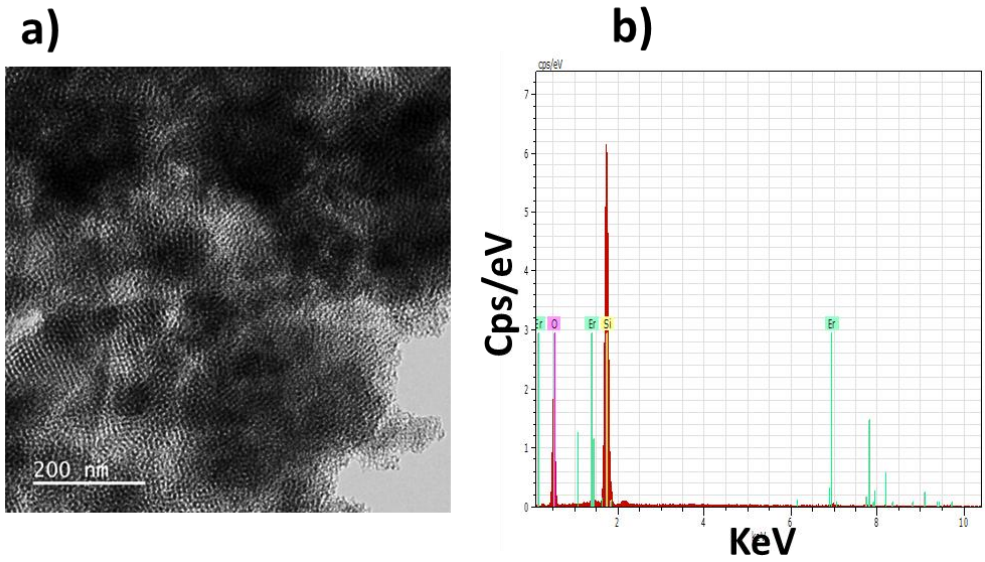

Fig. S1. FESEM and EDX analysis a) FESEM of KIT-6 b) EDX of Er doped silica heat treated at 1000^{O}C.

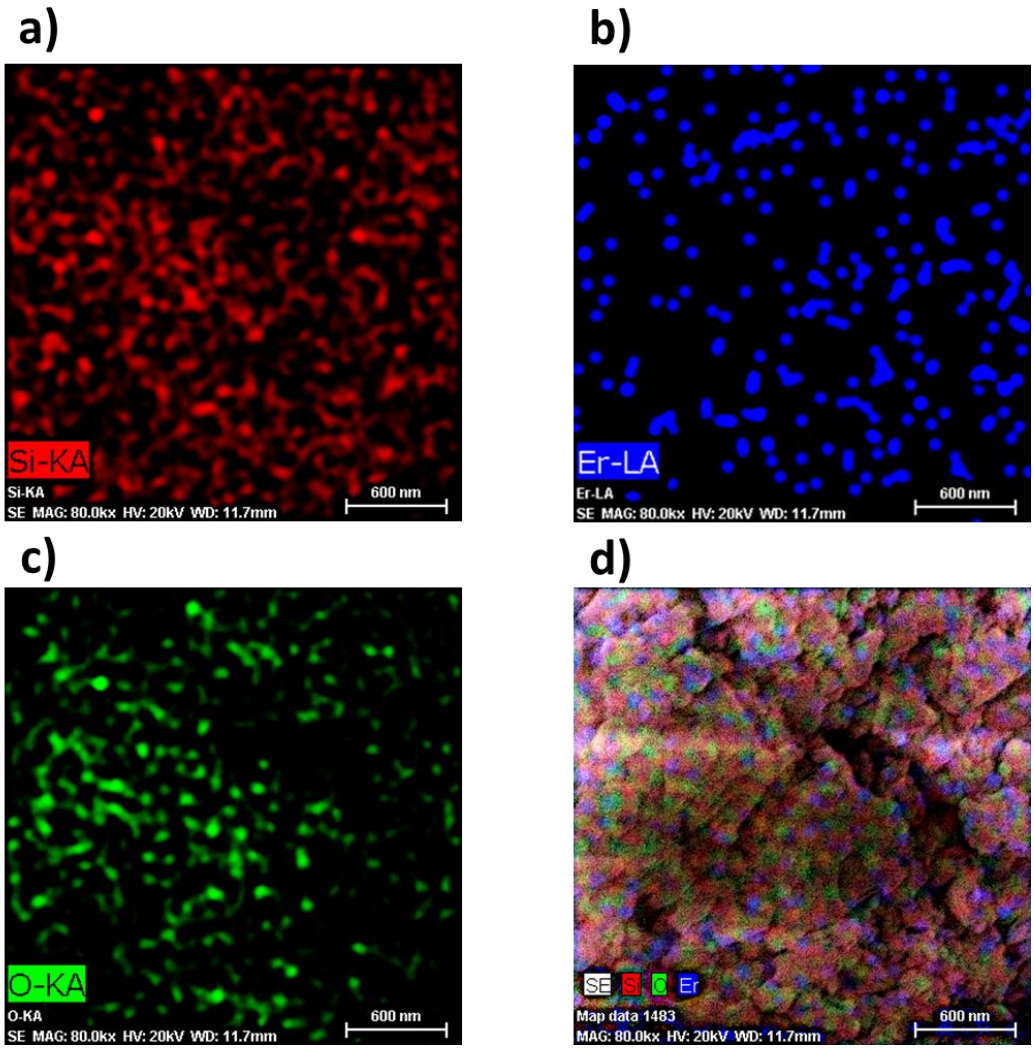

Fig. S2. FESEM mapping of Er doped silica a) Si b) Er c) O d) Si, O and Er together

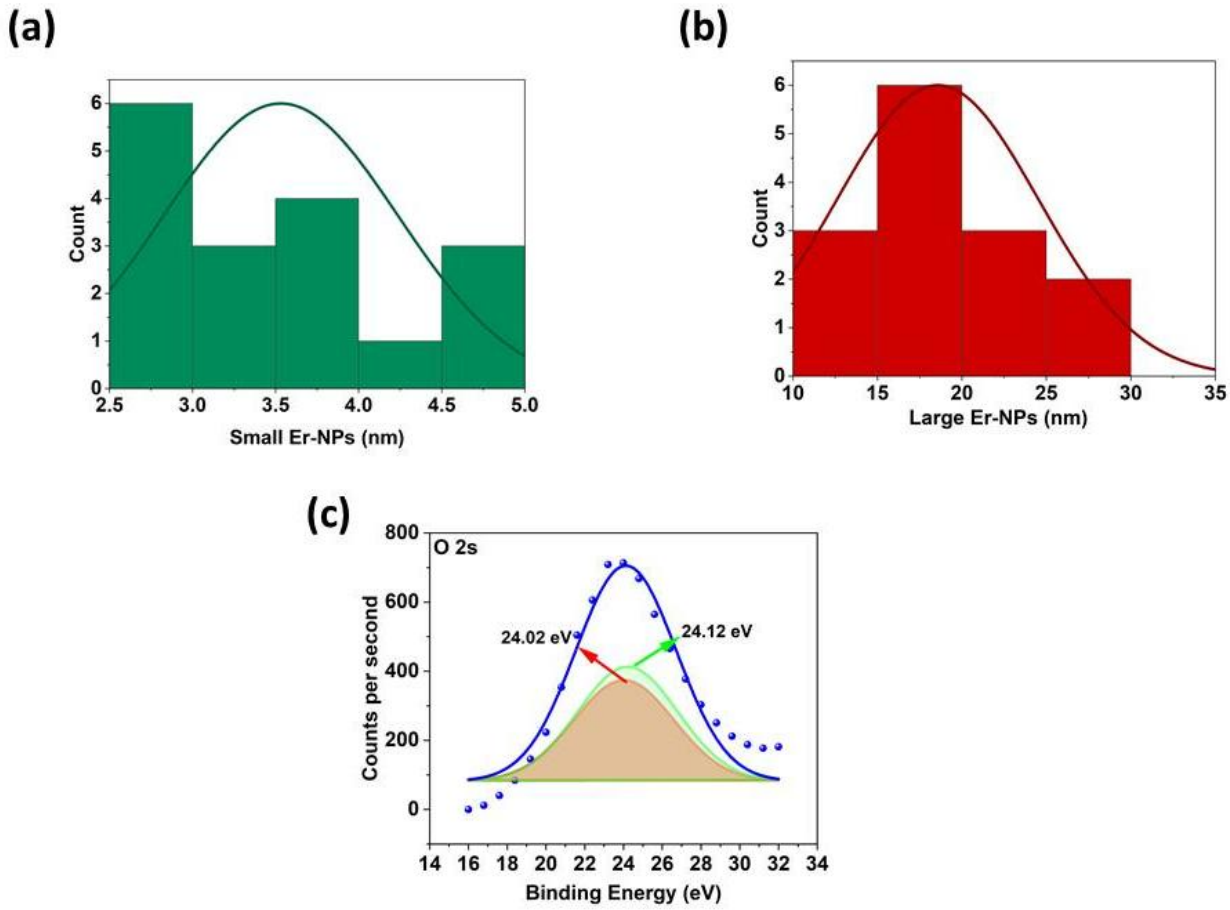

Fig. S3. Er_2O_3 nanoparticles sizeAnalysis of (a) small Er_2O_3 nanoparticles distribution, (b) large Er_2O_3 nanoparticles distribution, and (c) xps analysis of O 2S of Er doped silica.