Ce-doped yttrium silicate nanoscintillators prepared by reactive nanocasting: towards porous scintillating silicate monoliths for gas detection.

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Among high-performance scintillating materials, cerium-doped rare-earth silicates, such as Ce:RE_2SiO_5 and Ce:$RE_2Si_2O_7$, have garnered significant attention for their high light yields and rapid response times. However, as highlighted by Dujardin et al., an emerging sixth phase in scintillator research focuses on nanoscintillators,[1] where the synthesis of oxide-based nanostructures remains challenging. Preserving crystallinity, avoiding sintering, and maintaining a controlled nanostructure are critical yet elusive goals.

In this work, we introduce a novel reactive nanocasting approach to synthesize Ce-doped yttrium silicate (Ce:$Y_2Si_2O_7$) nanostructured scintillators. This template-based method enables control over nanostructure and composition, leveraging mesoporous silica templates (Figure 1). Through systematic optimization of synthesis parameters, including precursor ratios, impregnation conditions, and annealing temperature, we successfully produce 80-nm, unsintered nanoparticles composed of a Ce:$Y_2Si_2O_7$/amorphous silica nanocomposite. Structural characterization *via* XRD and TEM confirms the formation of yttrium silicate, while photoluminescence (PL) spectroscopy reveals the characteristic Ce^{3+} emission, validating the material's optical properties. Preliminary results demonstrate the potential of this method to fabricate porous, scintillating monoliths, a promising architecture for applications such as radioactive gas detection.[2]

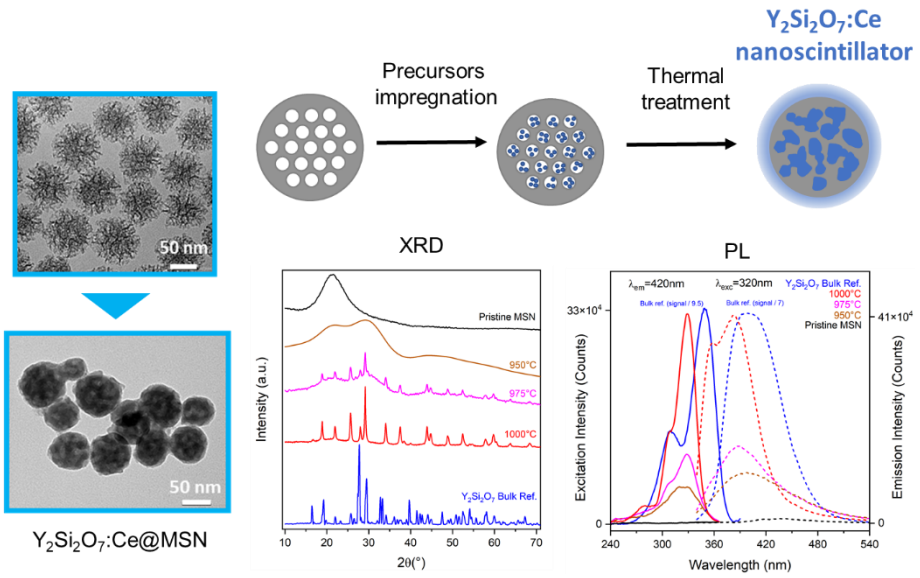

Figure 1: TEM images (left) and scheme (top) illustrating the process of reactive nanocasting starting from stellate mesoporous silica nanoparticles. XRD and PL of samples prepared by reactive nanocasting and annealed at various temperatures.

[1] C. Dujardin, A. Bessière, A. Bulin, F. Chaput, B. Mahler, *Advanced Optical Materials* **2025**, *13*, DOI 10.1002/adom.202402739.

[2] R. Marie-Luce, P. Mai, F. Lerouge, Y. Cheref, S. Pierre, B. Sabot, F. Chaput, C. Dujardin, *Nat. Photon.* **2024**, DOI 10.1038/s41566-024-01507-x.