



Letter

Process intensification for rare-earth doped luminescent nanomaterials

Kai Liu *, Hongjie Zhang

Department of Chemistry, Tsinghua University, Beijing 100084, China



Rare-earth doped luminescent nanomaterials are attractive and have many potential applications in health, energy, information and safety area [1]. Similar to most chemical processes, the process to synthesize luminescent nanomaterials is complicated and it needs a combination of a series of unit operations including mixing of the reactants, critical nuclei, growth of particles, separation, and drying. Therefore, the development of scale-up synthesis methods is becoming important for translational applications. Many previous studies have focused on the reactions in autoclave reactors and the influence of the molar ratio of reactants, solvent types, surfactants, reaction temperature, reaction time, and other related factors. On the other side, it is also important to consider what types of reactors might be used to achieve the preparation of rare-earth luminescent nanomaterials in high quality and large scale.

Recently, Wang and co-workers at Beijing University of Chemical Technology introduced high gravity technology (HIGEE) for synthesis of rare-earth luminescent nanophosphors (Fig. 1) [2]. The process intensification was achieved in the high gravity rotating packed bed (RPB). Due to the high gravity environment and porous structure of the packing inside the RPB, the liquid is distorted, splited, and becomes separated tiny droplets. The mass transfer and micromixing of the reactants were significantly intensified and the two phases of water and oil were rapidly emulsified to form small droplets, which then acted as micro-reactors for the formation of nanoparticles. As a result, the nanophosphors exhibited relatively high quantum efficiency. Under excitation of deep ultraviolet light, the $\text{CaMoO}_4\text{:Na}^+, \text{Eu}^{3+}$ nanophosphors exhibit red emission at peak wavelength of 615 nm and quantum yield of up to 35.01% and the $\text{CaMoO}_4\text{:Na}^+, \text{Tb}^{3+}$ nanophosphors exhibit green emission at peak wavelength of 543 nm with quantum yield of up to 30.66% [2]. Both of the quantum yield values are promising and superior to other reported $\text{CaMoO}_4\text{:Na}^+, \text{Eu}^{3+}(\text{Tb}^{3+})$ nanophosphors.

In other studies by the same group, the applications of RPB reactors to intensify the synthesis processes of rare-earth doped Gd_2O_3 nanoparticles [3] and NaYF_4 nanorods [4] have been successfully achieved. Thus, we conclude that the HIGEE technology is a promising platform for the synthesis of rare-earth luminescent nanomaterials.

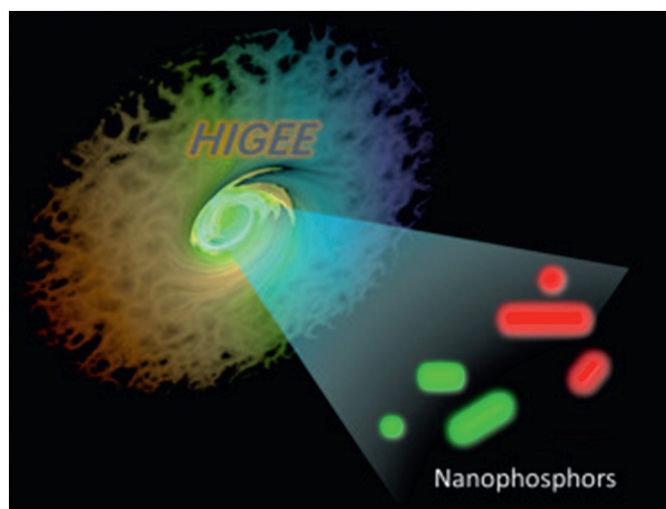


Fig. 1. Illustration of high-gravity-assisted synthesis of rare-earth doped nanophosphors. Adapted with permission from Ref. [2].

References

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* Corresponding author.

E-mail address: kailiu@tsinghua.edu.cn (K. Liu).