Highly dispersible crystalline nanobundles of YPO_4 and In (Eu, Tb)-doped YPO_4 as efficient bio-labels

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Considerable attention has recently been paid to the development of rare earth-based luminescent nanomaterials for cell labelling or bioimaging, mainly because of their attractive properties such as tunable emission colours, a large stokes shift, sharp emission spectra, and long fluorescence lifetime. Their high chemical and photochemical stability, flexibility of excitation wave-lengths, suitability for multiphoton and up-conversion excitation, low toxicity and reduced photobleaching are added advantages.

We present herein an efficient and rapid microwave irradiation-based liquid-phase route to the synthesis of highly dispersible and well crystallized nanobundles (Figure 1) of undoped and Ln^{3+} (Eu and Tb)-doped YPO_4 , using water as solvent and without using any structure-directing agents.

Figure 1: XRD pattern of the as-prepared YPO_4 product prepared after 30 min of microwave irradiation.

TEM and HRTEM analysis reveals that the as-prepared product consists of lenticular-shaped, bundle-like structures made of very small nanorods (Figure 2).

The Eu- and Tb-doped YPO_4 nanobundles have good luminescence properties, and experiments show that HeLa cells labelled with them display bright red and green intracellular luminescence with. These phosphate nanobundles show little

toxicity towards cells both with respect to concentration and duration of exposure, which makes them promising as biological fluorescent labels (Figure 3).

Figure 2: TEM image of the as-prepared YPO_4 nanobundles (a, b). The inset in (a) shows the SAED pattern indexable to tetragonal YPO_4

Figure 3: HeLa cells labelled with Eu- and Tb-doped YPO_4 nanobundles and the effect of these doped nanobundles at different concentrations on the viability of HeLa cells