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EASY SYNTHESIS AND FUNCTIONALIZATION OF SMALL UP-CONVERTING NANOPARTICLES TOWARDS ADVANCED BIOMEDICAL APPLICATIONS

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The last decade has seen a rapid increase of biomedical science discoveries, thanks, also to a stricter wedding between bio-compatible molecules and bright, luminescent inorganic nanoparticles, which have open new fields in theranostics (combined photodynamic therapy and bio-labelling). Up-converting (UC) nanomaterials are able to convert low-energy excitation (NIR) into high-energy emission (visible) and their application in biomedicine has been on the edge for the last 15 years, thanks to advantageous features such as low photo-bleaching, low-energy excitation (NIR), which accounts for low background fluorescence and higher penetration depth. The biggest challenge that the scientific community faces for their commercialization is to synthesize bright-emitting, phase-consistent and small-sized nanocrystals with easily scalable procedures. To date, Er^{3+}-Yb^{3+} co-doped β-NaYF4 is the most efficient UC material known. A key issue for its industrial scalability is to avoid extreme reaction conditions (around 350ºC, inert atmosphere, etc.) employed in the most widely spread laboratory procedures. Recently, microwave routes for the preparation of efficient UC nano-β-$NaYF_4$ materials have been explored; however, only cubic (α-$NaYF_4$) or mixed phase (α+ β) crystals were reported, leading to low efficient UC quantum yields. We report the formation of uniform-sized 15x60 nm lanthanide-doped β-$NaYF_4$ up-converting nanoparticles, under an easy and quick route that exploits homogeneous microwave heating. It permits bright emissions, easy post-synthesis functionalization and ease of scalability. Wavelengths modulation can be assessed through the incorporation of different actuators (Tb, Er, Tm). This discovery permits not only exploitation of the targeted bio-functionalization of the nanorods, but also the manufacture of small, portable biomedical devices.

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