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P15 - Investigations into doped NaYF4 nanocrystals as novel probes for ion beam induced fluorescence imaging

Friday, 11 July 2014 13:00 (1 hour)

Fluorescent probes that can elucidate biochemical mechanisms inside cells are paramount in understanding cell behaviour. We have demonstrated that proton induced fluorescence (PIF) has the capability of producing fluorescent images of cells at super-resolutions (ie below the diffraction limits of light) [1]. However, preliminary results have indicated that high levels of cell auto-fluorescence may mask the signal from conventional organic probes when using PIF, and any fluorescence induced using alpha particles appears to quench very quickly. We are therefore investigating probes which offer both high brightness and resistance to quenching for both PIF and alpha induced fluorescence. Candidates for a suitable probe include doped NaYF4 nanocrystals, which appear to be very bright when irradiated with both MeV proton and alpha beams, and moreover, they have a resistance to quenching even when irradiated using 1.6 MeV alpha particles.
We present results of a spectral study of these potential probes, with the aim of optimising the fluorescence yield for MeV ions, and show that both downconversion by direct atomic excitation and upconversion by energy transfer from sensitizers (Yb3+) to activators (Tm3+) contribute to the fluorescence emission. In this process, delta rays play an important role by raising both the sensitizers and activators to their exited states. Using a focused beam of 1.6 MeV alpha particles, we have achieved sub-40 nm lateral resolutions for fluorescence by imaging 1500 ×150 nm doped NaYF4 nanorods. These NPs exhibited good resistance to quenching and enough brightness to make them promising candidates for future fluorescence probes in PIF and alpha induced fluorescence studies.
[1] R. Norarat, V. Marjomäki, X. Chen, M. Zhaohong, R. Minqin, C. Chen, A.A. Bettiol, H.J. Whitlow, F. Watt. Ion-induced fluorescence imaging of endosomes. Nuclear Instruments and Methods in Physics Research B 306 (2013) 113–116.

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