In Vitro Cytotoxicity of Upconverting Tm/Er Co-Doped Layered Perovskite and their Nanosheets

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In this study, the upconversion properties of Tm^{3+}/Er^{3+} co-doped Ruddlesden-Popper type $K_2Ln_2Ti_3O_{10}$ (Ln: La, Tm, Er) layered perovskites and their exfoliated two-dimensional (2D) materials were reported [1,2]. The host lattice of the layered perovskite was preferred to study for the exfoliation procedure because of its low phonon energy. The excitation of co-doped $K_2Ln_2Ti_3O_{10}$ by a 980 nm NIR laser diode resulted in green and red visible emissions and a NIR emission corresponding to the $^4S_{3/2}\rightarrow{}^4I_{15/2}$ with $^2H_{11/2}\rightarrow{}^4I_{15/2}$ and $^4F_{9/2}\rightarrow{}^4I_{15/2}$ of the Er^{3+} transitions and $^3H_4\rightarrow{}^3H_6$ transition of the Tm^{3+}, respectively. According to the CIE chromaticity diagram the pure green and red emissions of the materials were obtained by tuning the activator and sensitizer amount in the host lattice of the layered perovskite. The 2D nanosheets derived by chemical exfoliation of the layered perovskites depicted an intense NIR emission with weak red and green emissions. The single oxide nanosheets had approximately 1.8 nm thickness and 2 µm lateral size. Moreover, MTT assay and Calcein/PI staining were performed to evaluate the cytotoxicity of non-doped and Tm^{3+}/Er^{3+} co-doped $K_2Ln_2Ti_3O_{10}$ perovskites and their 2D nanosheets on HEK293 and HepG2 cell lines. Even if the cell viability decreased with increasing concentration, both assays showed good cell viability at even 100 µg/mL. In addition to the intense luminescence and optical features of the 2D materials, the nanomaterials also demonstrated lower cytotoxicity than their bulk forms. This study was supported by the Scientific and Technological Research Council of Turkey (TÜBİTAK; Grant number 117M512).

References

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Figures

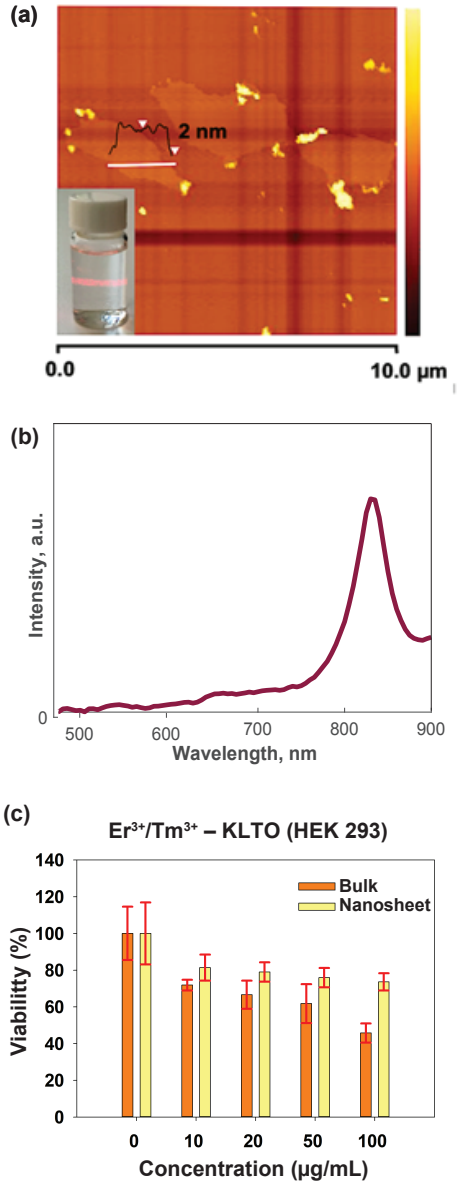

Figure 1. (a) AFM image with a height profile. The inset shows the Tyndall effect of the nanosheet solution (b) The upconversion emission spectrum of the exfoliated nanosheets derived from $K_2Ln_2Ti_3O_{10}$ co-doped with 20% Er^{3+}+ 2.5% Tm^{3+} (c) Cytotoxicity analyzes of $K_2Ln_2Ti_3O_{10}$ co-doped with 20% Er^{3+}+ 2.5% Tm^{3+} and their nanosheets for HEK 293 cell lines.