Upconversion emission from erbium doped sol-gel derived $BaTiO_3$ powders and coatings

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1. Introduction

Upconversion is a process where light can be emitted with photon energies higher than those of the light generating the excitation (www.rp-photonics.com/upconversion). Diverse inorganic matrices doped with trivalent lanthanides - erbium and holmium exhibit upconversion, transferring infrared light into visible. Thus the effect attracts attention for detection and visualization of infrared radiation. Recently we reported that sol-gel derived barium titanate possessing refractive index about 1.9 in amorphous state can be used as component of optical interference filter in combination with low refractive index films as silica [1] or magnesium fluoride. At the same time room-temperature luminescence of lanthanides in sol-gel derived barium titanate makes the material and method promising for light conversion [2, 3]. In this work we investigate erbium upconversion emission from sol-gel derived $BaTiO_3$ films and powders.

2. Experimental

Three types of Er-doped $BaTiO_3$ sol-gel derived samples were fabricated and annealed for 1 hour: (i) powder annealed at 1000 °C,(ii) Er-doped $BaTiO_3$ film on glass annealed at 450 °C and (iii) Er-doped $BaTiO_3$ powder annealed at 1000 °C and dispersed in SiO_2 film on silicon or glass substrates.

3. Results and Discussion

Erbium upconversion emission was observed from Er doped $BaTiO_3$ powder annealed at 1000 °C and Er doped $BaTiO_3$ powder annealed at 1000 °C and dispersed in SiO_2 film on silicon or glass. Typical room-temperature spectrum of upconversion PL is given in Figure 1. Intensive bands at 524, 554, 657, 799 and 840 nm, corresponding to $(^4F_{7/2}, ^2H_{11/2}) \rightarrow$ $^4I_{15/2}$, $^4S_{3/2} \rightarrow$ $^4I_{15/2}$, $^4F_{9/2} \rightarrow$ $^4I_{15/2}$, $^4I_{9/2} \rightarrow$ $^4I_{15/2}$ and $^4I_{9/2} \rightarrow$ $^4I_{15/2}$ transitions of trivalent erbium respectively are well resolved. The results might be interesting for solar cells on transparent substrates and silicon with convertors of infrared irradiation into visible [4] as well as for design of infrared detectors.

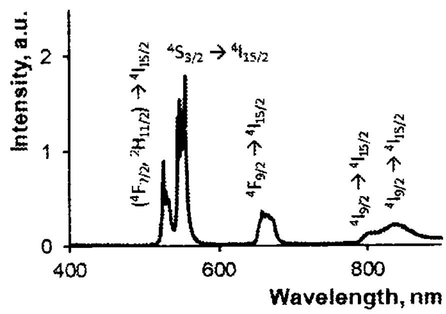

Figure 1: Upconversion emission spectrum of $BaTiO_3$:Er powder dispersed in SiO_2 film on silicon, excitation wavelength 980 nm

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5. References

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