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Abstract

Er^{3+} Wireless Temperature Sensor for Hyperthermia Treatment †

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Abstract: In recent years, the use of hyperthermia to induce the cellular activity of hippocampal neurons, which in vitro and in vivo experiments have shown to evoke a promising neural activity, has been explored. This is due to the hyperthermia effect, which improves the neurotransmission process, and this could be related to the fact that cells and neurons are temperature sensitive. However, if the temperature exceeds the physiological range (35–39 °C), abnormalities can occur as well as life-threatening health complications; for that reason, it is essential to have an accurate temperature monitor for such a technique. For that reason, the use of a non-invasive biosensor to monitor temperature changes remotely and that has a high temporal resolution is essential. In this work, the temperature-sensing properties of fluoroindate glasses doped with Er^{3+} and Yb^{3+} were examined with the aim of evaluating their potential as a wireless temperature sensor. The main advantage of the use of such a matrix is its low phonon energy, high refractive index, and transparency in the infrared spectra region. Their glass structure was analyzed using X-ray power diffraction (XRD), Fourier Transform Infrared spectroscopy (FTIR), and Raman spectroscopy, while their ability as a non-invasive temperature sensor was evaluated using radiative transition analysis, along with calculation of absorption, emission, and effective emission cross sections. Finally, adequate functional models of temperature sensing were established for Er, Yb co-doped glass systems utilizing temperature dependences of luminescence spectra.

Keywords: non-invasive temperature sensor; hyperthermia sensing; fluoroindate glasses; Er; Yb

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