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Modified Silicates as Dissolved Oxygen Sensors in Water: Structural and Optical Properties

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Abstract : Among different parameters, oxygen is one of the most important analytes of interest, dissolved oxygen (DO) concentration is very crucial and significant for various areas of physical, chemical, and environmental monitoring. Herein we report oxygen-sensitive luminophores -based lanthanum(III) trifluoromethanesulfonate), $[La]^{3+}$ was encapsulated into SiO_2-based xerogel matrix. The nanosensor is composed of organically modified silica nanoparticles, doped with the luminescent oxygen–sensitive lanthanum(III) trifluoromethanesulfonate complex. The precursor materials used for sensing film were triethyl ethoxy silane (TEOS) and (3-Mercaptopropyltriethoxysilane) (MPTMS- TEOS) used for SiO2-baed matrices. Brunauer–Emmett–Teller (BET), and BJH indicate that the SiO_2 transformed from microporous to mesoporous upon the addition of La^{3+} luminophore with increased surface area (SBET). The typical amorphous SiO_2 based xerogels were revealed with X-Ray diffraction (XRD) and Selected Area Electron Diffraction (SAED) analysis. Scanning electron microscope- (SEM) and transmission electron microscope (TEM) showed the porous morphology and reduced particle for SiO_2 and La-SiO_2 xerogels respectively. The existence of elements, siloxane networks, and thermal stability of xerogel was confirmed by energy dispersive spectroscopy (EDS), Fourier-transform infrared spectroscopy (FTIR), and Thermographic analysis (TGA). UV-Vis spectroscopy and photoluminescence (PL) have been used to characterize the optical properties of xerogels. La-SiO_2 demonstrates promising characteristic features of an active sensing film for dissolved oxygen in the water. Keywords: Sol-gel, ORMOSILs, encapsulation, Luminophores quenching, O_2-sensing

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