INVESTIGATING THE OPTICAL ATTRIBUTES OF SELAGIBENZOPHENONES AND THEIR COMPLEXES WITH GRAPHENE QUANTUM DOTS

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Selagibenzophenones (SelB) constitute a group of substances derived from plants of the Selaginella genus. These plants are traditionally used in Chinese and Indian medicine to treat conditions such as asthma or local injuries. Research has indicated that these substances possess various biological properties, including antibiotic, antibacterial, or anticancer effects.

Graphene quantum dots (GQD) are nanoparticles with unique and beneficial characteristics, such as chemical stability, low toxicity, small size enabling good penetration, and the ability to fluoresce with quantum yield of 50 percent. GQDs can be utilized as drug nanocarriers, necessary for delivering the active substance to the target cell, thereby protecting other cells.

The aim of the study was to examine the changes over time in the fluorescence spectra of SelB molecules and to assess the formation of complexes with GQD in solvents such as dimethyl sulfoxide (DMSO) and tetrahydrofuran (THF). The optical properties of SelB, GQD, and their mutual complexes were investigated using optical methods. During the study, the absorption, fluorescence, fluorescence excitation, Coherent Anti-Stokes Raman Scattering (CARS) spectra, and fluorescence quenching kinetics of SelB, GQD, and a mixture of GQD+SelB in a 1:15 ratio were measured. The size of the formed complexes was measured utilizing CARS microscopy.

In tetrahydrofuran (THF) solvent, the spectra of the substances do not yield meaningful results because the absorption, fluorescence and fluorescence excitation spectra overlap with the material spectra. However, the measured fluorescence quenching kinetics in this solvent reveal the formation of complexes. When measuring the fluorescence quenching kinetics at 445nm (GQD maximum), the decay of GQD is monoexponential, with an average relaxation time of $\approx$ 9ns. In contrast, the relaxation times for the mixtures are approximately two times shorter (ranging from 4.8ns to 5.3ns) with a three-exponential approximation.

In the DMSO solvent, the spectras also show formation of complexes. The absorption spectra show the disappearance of one of the GQD absorption bands, the one peaking at 250nm. The fluorescence spectra provide evidence of complex formation, when excited with 350nm light, the spectras of the mixtures are similar to GQD fluorescence spectra, but with a slightly different spectral shape. Excitation of the complex with UV light (250-290nm) results in fluorescence spectra that is similar to the corresponding SelB materials. The fluorescence excitation spectra of the mixtures, regardless of the chosen emission wavelength, closely match the excitation spectra of individual SelB molecules. The fluorescence quenching kinetics also suggest molecular interaction. For the complexes, the relaxation durations are approximately four times shorter than GQD relaxations (ranging from 1.5 to 2.2ns) with two-exponential approximation.