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Novel selective and sensitive optical chemosensor based on phenylfluorone derivative for detection of Ge(IV) ion in aqueous solution

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ABSTRACT

A water soluble chemosensor for Ge⁴⁺ ion based on fluorone derivative containing 3,4-*bis*(2-(diethylamino)-2-oxoethoxy)phenyl (**R8**) has been synthesized. The binding abilities between **R8** and 10 equiv. of Na⁺, K⁺, Ca²⁺, Fe²⁺, Cu²⁺, Cd²⁺, Hg²⁺, Pb²⁺, Al³⁺, Cr³⁺, Fe³⁺ and Ge⁴⁺ ions in 1% v/v EtOH-water (*tris*-buffer pH 7.0) were studied using UV-vis and fluorescence spectrophotometry. When observed by naked-eyes, the color of **R8** changed from yellow-orange to pink and the fluorescent color changed from green to non-fluorescence when complexed with Ge⁴⁺ ion. The spectral analysis showed that UV-vis absorption and fluorescence emission intensity of **R8** decreased dramatically when Ge⁴⁺ ion was added comparing with other ions. To explain this behavior, the quantum calculation was performed using the hybrid density functional at B3LYP /LanL2DZ level of theory. The calculated orbital energies indicated that the decreasing of UV-vis absorption and the quenching of fluorescence were due to the complexation induced metal to ligand charge transfer. The association constants (K_a) of **R8**-Ge⁴⁺ complexes calculated from Benesi-Hildebrand equation was $6.21 \times 10^5 \text{ M}^{-1}$. The UV-vis detection limit for Ge⁴⁺ was $4.40 \times 10^{-7} \text{ M}$ which was three orders of magnitude lower than those of Al³⁺, Cd²⁺, Cu²⁺ and Na⁺ ion.

Keywords: Phenylfluorone · naked-eye · Chemosensor · Germanium(IV) · DFT/LanL2DZ

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