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pH and copper ion luminescence on/off sensing by a dipyrazinylpyridine-appended ruthenium complex

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Abstract

A new ruthenium(II) complex of $[\text{Ru}(\text{bpy})_2(\text{HL}^1)](\text{ClO}_4)_2 \cdot 4\text{H}_2\text{O}$ ($\mathbf{1} \cdot 4\text{H}_2\text{O}$) {bpy = 2,2'-bipyridine and $\text{HL}^1 = 2-(4-(2,6\text{-di}(\text{pyrazin-2-yl})\text{pyridin-4-yl})\text{phenyl})-1H\text{-imidazo}[4,5-f][1,10]\text{phenanthroline}$ } was synthesized and characterized by elementary analysis, proton nuclear magnetic resonance spectroscopy and mass spectrometry. The ground- and excited-state acid-base properties of $\mathbf{1}$ were studied by means of UV-vis absorption spectrophotometric and spectrofluorimetric titrations in 100:1 (v/v) Britton-Robinson buffer/ CH_3CN solution in combination with luminescence lifetime measurements. The complex exhibited two-step separate protonation/deprotonation processes in both the ground and excited states, acting as pH-induced “off-on-off” luminescence switches ($I_{\text{on}}/I_{\text{off}} = 100.0$ and 3.96). Importantly, $\mathbf{1}$ also acted as a highly selective luminescent chemosensor toward Cu^{2+} over other metal cations tested (Na^+ , Mg^{2+} , Mn^{2+} , Fe^{2+} , Fe^{3+} , Co^{2+} , Ni^{2+} , Cu^{2+} , Zn^{2+} , Cd^{2+} , Hg^{2+} and Ag^+).

Keywords: Ruthenium(II) complex, dipyrazinylpyridine, pH, copper, luminescent chemosensor

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