



A Co-Crystallised Cobalt(II) Cluster of Pyridinedicarboxylic Acid (PDC) as a Luminescent Material for Selective Sensing of Methanol

Victoria T. Olayemi^{1,2} · Adedibu C. Tella^{1,3} · Folahan A. Adekola¹ · Hadley S. Clayton³ · Adetola C. Oladipo^{1,4} · Gift Mehlana⁵ · Adeniyi S. Ogunlaja⁶ · Oluwatobi S. Oluwafemi⁷ · Joseph O. Ogar⁸ · Stephen P. Argent⁸ · Robert Mokaya⁸

Received: 29 December 2020 / Accepted: 4 May 2021

© The Author(s), under exclusive licence to Springer Science+Business Media, LLC, part of Springer Nature 2021

Abstract

A luminescent Cobalt(II) co-crystal $[\text{Co}_{13}(\text{PDC})_{16}(\text{H}_2\text{O})_{24} \cdot 7\text{H}_2\text{O}]$ **1** (where H_2PDC = 2,6-pyridinedicarboxylic acid) have been prepared by oven-heating and slow evaporation of solvent. Single crystal X-ray diffraction (SCXRD) analysis revealed that **1** is a mixture of complexes that crystallizes in the triclinic space group $P\bar{1}$ and the geometry around the Co(II) ions is octahedral. The structure is extensively imbued with hydrogen bonding that helps in stabilizing the complex. Thermogravimetric analysis indicates that **1** is thermally stable up to 364 °C. The luminescence properties of **1** revealed a strong emission centered at 437 nm (λ_{ex} = 345 nm) assigned to ligand to metal charge transfer (LMCT). The luminescence sensing of **1** towards volatile organic molecules were also examined. However, **1** displayed a turn off towards methanol compared to other molecules with high quenching efficiency and low limit of detection (3.5×10^{-4} vol%). The results show excellent selectivity and high sensitivity. Powder X-ray diffraction studies revealed that the structural integrity of the complex was maintained after exposure to methanol vapour. Theoretical studies also revealed small binding energy (−413.2 au) and low energy gap (1.19) for 1-CH₃OH adduct.

Keywords Luminescence · Single crystal XRD · Solvothermal · Triclinic · Quenching