

Multifunctional metal–dithiolate architectures: Bridging coordination chemistry, molecular memory, and anticancer potential through mixed-ligand transition metal(II) complexes

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The rational design of multifunctional coordination compounds remains a key challenge at the interface of inorganic chemistry, materials science, and biomedicine. In this work, a new family of mixed-ligand M(II) complexes (M = Ni, Co, Zn, and Cd) incorporating the sulfur-rich 1-cyano-carboethoxyethylene-2,2-dithiolate (CED²⁻) and the rigid nitrogen-donor ligand 4,4'-bipyridine has been synthesized and systematically investigated. The four different complexes have been characterized by CHN analysis, molar conductivity, UV-Vis, fluorescence, and FT-IR spectroscopy, confirming bidentate S,S'-chelation of the dithiolate ligand alongside N-coordination of 4,4'-bipyridine. Thin-film morphological studies reveal distinct nanoscale surface features, indicating ligand-dependent aggregation behavior. Electrical measurements demonstrate reproducible write-once-read-many (abbreviated as WORM) type resistive switching with low set voltages, wide memory windows, and excellent retention, highlighting their promise for non-volatile molecular memory devices. Furthermore, *in vitro* cytotoxicity assays against A-549 lung cancer cells reveal significant antiproliferative activity for selected complexes, while maintaining appreciable biocompatibility toward normal lung epithelial cells. The combined optical, electrical, and biological performances underscore the potential of dithiolate-based mixed-ligand metal complexes as versatile platforms for next-generation electronic and therapeutic applications.

Keywords: Mixed-ligand coordination complexes, Dithiolate ligands, 4,4'-Bipyridine, Molecular memory (WORM), Cytotoxic activity