

## Heterodimetallic Ferrocenyl Dithiophosphonate Complexes of Nickel(II), Zinc(II) and Cadmium(II) as High Efficiency Co-Sensitizers in Dye-Sensitized Solar Cells

**Authors :** Tomilola J. Ajayi, Moses Ollengo, Lukas le Roux, Michael N. Pillay, Richard J. Staples, Shannon M. Biros Werner E. van Zyl

**Abstract :** The formation, characterization, and dye-sensitized solar cell application of nickel(II), zinc(II) and cadmium(II) ferrocenyl dithiophosphonate complexes were investigated. The multidentate monoanionic ligand  $[S_2PFC(OH)]^-$  (L1) was synthesized from the reaction between ferrocenyl Lawesson's reagent,  $[FcP(=S)\mu-S]_2$  (FcLR), (Fc = ferrocenyl) and water. Ligand L1 could potentially coordinate to metal centers through the S, S' and O donor atoms. The reaction between metal salt precursors and L1 produced a Ni(II) complex of the type  $[Ni\{S_2P(Fc)(OH)\}_2]$  (1) (molar ratio 1:2), a tetranickel (II) complex of the type  $[Ni_4\{S_2OP(Fc)\}_2]_2$  (2) (molar ratio (1:1), as well as a Zn(II) complex  $[Zn\{S_2P(Fc)(OH)\}_2]$  (3), and a Cd(II) complex  $[Cd\{S_2P(Fc)(OH)\}_2]$  (4). Complexes 1-4 were characterized by  $^1H$  and  $^{31}P$  NMR and FT-IR, and complexes 1 and 2 were additionally analysed by X-Ray crystallography. After co-sensitization, the DSSCs were characterized using UV-Vis, cyclic voltammetry, electrochemical impedance spectroscopy, and photovoltaic measurements (I-V curves). Overall finding shows that co-sensitization of our compounds with ruthenium dye N719 resulted in a better overall solar conversion efficiency than only pure N719 dye under the same experimental conditions. In conclusion, we report the first examples of dye-sensitized solar cells (DSSCs) co-sensitized with ferrocenyl dithiophosphonate complexes.

**Keywords :** dithiophosphonate, dye sensitized solar cell, co-sensitization, solar efficiency

**Conference Title :** ICSAFEP 2018 : International Conference on Sustainable Alternative Fuels and Energy Production

**Conference Location :** San Francisco, United States

**Conference Dates :** November 26-27, 2018