Chemistry Select

Ajayi, TJ; Ollengo, M; Le Roux, Lukas; Pillay, MN; Staples, RJ; Biros, SM; Wenderich, K; Mei, B and van Zyl, WE

Heterodimetallic Ferrocenyl Dithiophosphonate Complexes of Nickel (II), Zinc (II) and Cadmium (II) as Sensitizers for TiO2-based dye-sensitized solar cells

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 [S2PFc(OH)]- (L1) was synthesized. The reaction between metal salt precursors and L1 produced Ni(II) complexes of the type [Ni{S2P(Fc)(OH)}2] (1) (molar ratio 1:2), and a tetranickel(II) complex of the type [Ni2{S2OP(Fc)}2]2 (2) (molar ratio (1:1). It also produced a Zn(II) complex [Zn{S2P(Fc)(OH)}2]2 (3), and a Cd(II) complex [Cd{S2P(Fc)(OH)}2]2 (4). Complexes 1–4 were characterized by 1H and 31P NMR, FTIR and elemental analysis, and complexes 1 and 2 were additionally analyzed by X-ray crystallography. The first examples of dye-sensitized solar cells (DSSCs) co-sensitized with ferrocenyl dithiophosphonate complexes 1–4 are reported. Co-sensitization with the ruthenium dye N719, produced the dye materials (3)-N719 (=8.30%) and (4)-N719 (=7.78%), and they were found to have a better overall conversion efficiency than the pure Ru N719 dye standard (=7.14%) under the same experimental conditions. The DSSCs were characterized using UV/vis, cyclic voltammetry, electrochemical impedance spectroscopy (EIS), photovoltaic- (I-V curves), and performing incident photon-to-current efficiency (IPCE) measurements.