Synthesis and Characterization of Polymeric [Ru^{2+}] Complexes and their Application as Dyes in Solar Cells

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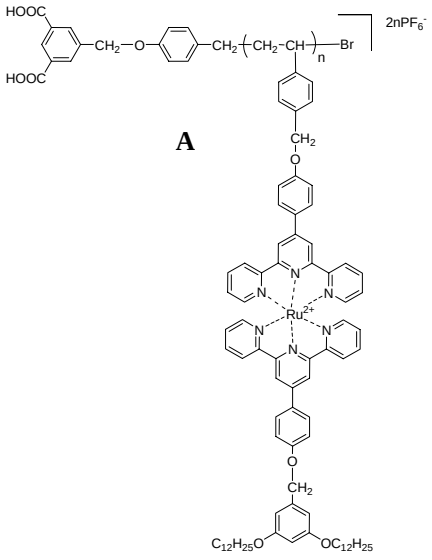
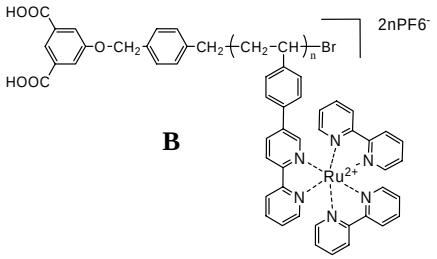
The renewable energy technologies aim in the long run, to efficiently contribute to the solution of the energy problem both economically and environmentally friendly. In respect to the materials science, the development of energy related materials is of great interest and one of the main activities focused into Organic Solar Cells. These are categorized to Cells of Organic Molecules, Polymeric/Plastic Cells (OPVs) and Dye Sensitized Cells (DSSCs). Our work is mainly focused in the development of the two latter systems, the Plastic and the Dye Sensitized Solar Cells.

Our main objective in DSSCs is to replace the commonly used dyes (complexes of transition metal ions with organic molecules) with polymeric dyes, thus utilizing the advantages of the polymers' character in a sensitized Solar Cell. Such materials, consist of polymeric complexes of the Ruthenium (II) ion, with tridentate or bidentate ligands like 2,2':6',2''-terpyridine and 2,2'-bipyridine, respectively.

More specifically in this work we prepared terpyridine and bipyridine vinyl monomers and in consequence we performed Atom Transfer Radical Polymerization, using functional initiators (carrying carboxylic groups aiming at the attachment of the dye onto the TiO_2) leading to homopolymers of controlled architecture (e.g. homopolymer **A** and **B**). After complexation with Ruthenium (II) ions, these materials can be applied as dyes in Hybrid Photovoltaic Cells (PVs).

Evaluation of these new materials in respect ot their photovoltaic performance was attended. As an example, homopolymer **B** gave a short circuit photocurrent density J_{sc}= 39 μA/cm^2, open circuit potential V_{oc}= 350 mV, fill factor ff=0.39 and power conversion efficiency n=0.005%. In an attempt to improve the efficiency of these systems we have managed to combine the polymeric dyes with the electrolyte most commonly used; poly(ethylene oxide). This new random copolymers of various ratios are now under investigation for their photovoltaic performance.





Dye	JSC (μA/cm2)	VOC (mV)	ff	n (%)
A	*54*	*248*	*0.44*	*0.006*
B	*39*	*350*	*0.39*	*0.005*
Reference:N719	*9290*	*583*	*0.53*	*2.87*

Aknowledgement: Financial support for this project from the Greek Ministry of Development under the research grant PENED 03ED118 "Organic Solar Cells" is gratefully acknowledged.This research project (PENED) is co-financed by E.U.-European Social Fund (75%) and the Greek Ministry of Development-GSRT (25%).