# Design of high-efficiency solid-state dye-sensitized solar cells using coupled dye mixtures

Jayasundera Bandara*, Hasitha Weerasinghe

*Institute of Fundamental Studies, Hantana Road, Kandy, Sri Lanka*

Received 27 April 2005
Available online 28 June 2005

**Abstract**

A solid-state dye-sensitized solar cell comprising dye mixtures of [Ru(2,2-bpy-4,4′-dicarboxylic acid)$(NCS)_2$] and [Ru(4,4′,4″-tricarboxy-2,2;6,2″-terpy)$(NCS)_3$] on $TiO_2$ thin film was fabricated. The different optical properties of dyes results in increased photocurrent and incident photon to photocurrent efficiency (IPCE). The multiple dye system showed the short circuit current ($I_{sc}$) of 10.2 mA/cm$^2$ and a cell efficiency ($\eta$) of 2.8 while broadening the spectral sensitivity of the cell. When a single dye is used, $I_{sc}$ of 6 and 5 mA/cm$^2$ and cell efficiency of 1.7 and 1.2 were observed for [Ru(4,4-bis(carboxy)-bpy)$_2$$(NCS)_2$] (dye 1) and [Ru(2,2′,2″-$(COOH)_3$-terpy)$(NCS)_3$] (dye 2), respectively. Additionally, the resulting IPCE for the solar cell consisting of dye mixture was 50% at wide wavelength range from 530 to 650 nm while for the dye 1, 32% IPCE was observed at 535 nm while for the dye 2, highest IPCE value observed was 20% at 620 nm.


*Keywords:* Dye-sensitization; Solid-state solar cell; $TiO_2$; Charge separation; Covalently attached dyes; Dyad