Synthesis Of Metal-Free Organic Dye For Dye Sensitized Solar Cell

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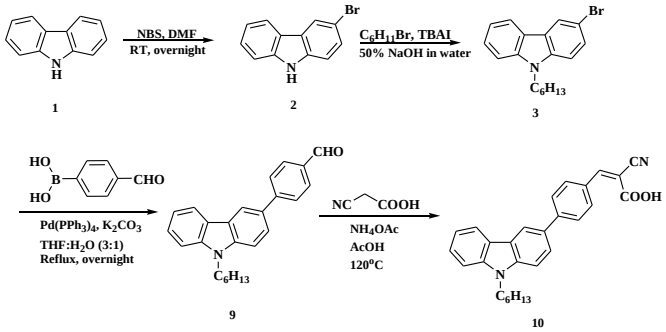
Abstract: A D-π-A type of dye was synthesized containing carbazole unit as electron donor, phenyl ring as a π-linker and cyano acetic acid as an acceptor that absorbs light in the range of 300-530 nm. The structure of dye and its intermediates were confirmed by NMR, Mass and FT-IR spectroscopic techniques. Optical properties of dye were investigated using UV-visible spectroscopy.The band gap of dye was calculated to be 2.616 eV. Fabrication of Dye Sensitized Solar Cell (DSSC) using the synthesized dye and device properties were analyzed .Fill factor and efficiency of dye is found to be 0.55 and 0.74% respectively.

Materials and methods:

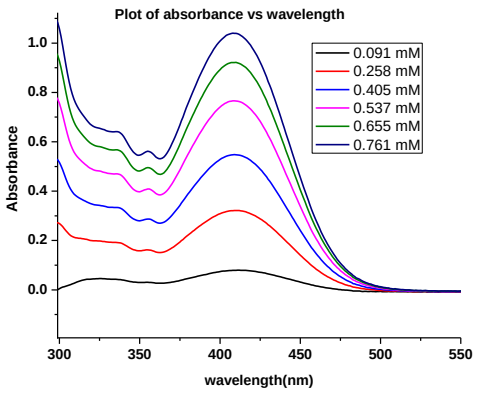
All the materials used for the synthesis of dye were purchased from Sigma Aldrich. Ultra sonication was done in a Branson 2510 ultra sonicator to disperse and make uniform composites. UV–Visible spectra were recorded on a Perkin–Elmer Lambda 25 UV–Visible spectrophotometer. Varian –AS 400 MHz NMR spectrometer was used to record NMR spectra. Spin coating were done on SPIN 150 spin coater. Photovoltaic properties of the device were measured using an Oriel Sol3A Class AAA Solar Simulator and IQE-200 Quantum Efficiency Measurement System.

Sensitizer synthesis:



Result and discussion:

UV visible studies-



This shows plot of absorbance vs wavelength. The dye shows absorption from 300 to 530 nm range

Calculation of extinction coefficient:

From the above Figure, the value of extinction coefficient was found to be 13780 which is obtained by the value of slope of absorbance vs concentration.

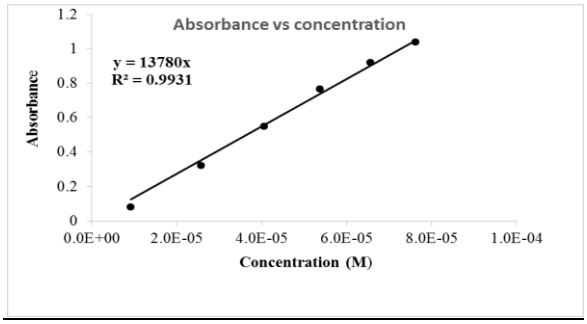


Figure: *Plot of absorbance vs concentration of dye.*

Photovoltaic properties of DSSC:

The incident photon-to-current conversion efficiency (IPCE) was measured as a function of wavelength from 320 to 800 nm by using a Model QE/IPCE system (PV Measurements, Inc.) Solar cell efficiency is the ratio of the electrical output of a solar cell to the incident energy in the form of sunlight. The (η) efficiency of Solar cell is the percentage of the solar energy to which the cell is exposed that is converted into electrical energy. This is calculated by dividing a cell's power output (in watts) at its maximum power point (P_m) by the input energy (E, in W/m^2) and the surface area of the solar cell (A_c in m^2).

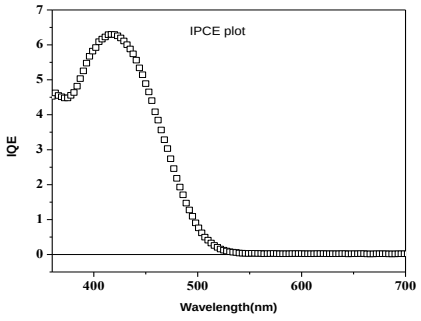


Figure: *Plot of IQE vs. wavelength for carbazole based dye.*

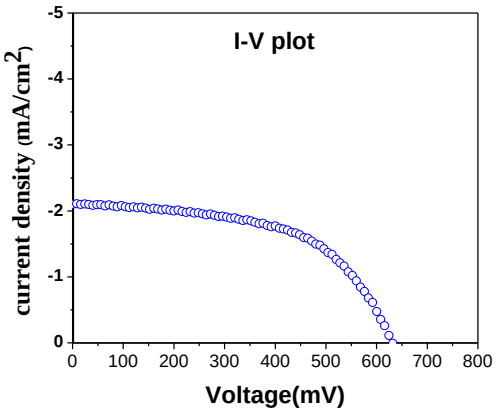


***Figure: I-V** characteristic curve of Dye*

Conclusion:

A highly conjugated dye was prepared using careful organic synthetic methods and well characterized. The UV-visible spectra of dye showed that it absorbs a light in the range of 300-530 nm. The efficiency and fill factor of newly synthesized dye was found to 0.74% and 0.55 respectively

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