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| Title | Characterization and Comparison of DSSCs Fabricated with Black Natural Dyes Extracted from Jamun, Black Plum, and Blackberry | | |
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| Abstract |  |
| In this report, natural dyes extracted from three different, black-colored fruits were used as photosensitizers for the construction of dye-sensitized solar cells (DSSCs). The natural dyes were extracted from the dark-colored peels of jamun (also known as Indian black plum), black plum, and blackberry fruit. These natural dyes contain polyphenolic compounds—most prominently anthocyanins—which interact strongly with titanium dioxide (TiO2) semiconductors and accordingly enhance the efficiency of DSSCs. The natural dyes extracted from the various fruits were characterized utilizing UV-Vis and fluorescence spectroscopy. The interaction between the dyes and TiO2 was monitored with FTIR and Raman spectroscopy. The fabricated DSSCs were characterized via current–voltage measurements and electrochemical impedance analysis. DSSCs fabricated with jamun produced the highest efficiency of 1.09% with a short-circuit current of 7.84 mA/cm2, an open-circuit voltage of 0.45 V, and a fill factor of 0.31. The efficiencies of the DSSCs from black plum and blackberry were 0.55% and 0.38%, respectively. The flow of charge occurring at the interfaces between the natural dye and the TiO2 layers were investigated using electrochemical impedance spectroscopy (EIS). To the best of our knowledge, this study is the first to directly compare three distinct types of black DSSCs. Computation analysis was also carried out utilizing SCAPS-1D software (version 3.3.07), which revealed how the type of defects in the devices impacts their performance. | |