Synthesis of Flexible Anodic Nanomaterials for Bio-inspired Solar Energy Production

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Economic distress resulting from dependence on diminishing fossil fuels has emphasized the urgent need for new, clean, and efficient fuel sources. Developments in understanding solar energy, a versatile, renewable resource, have resulted in the production of bio-inspired materials, including solar cells, which harness the power of light to produce energy. Commercially available solar cells face severe cost, efficiency, and structural limitations, which must be overcome as the energy crisis progresses. Building on a molecular understanding of photosynthesis and the established electron-transfer principles of dye-sensitized solar cells (DSSC), this work has begun to develop flexible anodic nanomaterials for use in solar energy production. The highly conductive polyaniline emeraldine base (EB) was synthesized and dispersed in thin, flexible polyvinyl alcohol (PVA) films using a novel microwave method. The resulting films were coupled (surface or embedded) with a dye-modified titanium dioxide (TiO_2) nanoparticle dispersion which serve as the antenna for photon capture. Initial results indicate that the voltage produced by a DSSC with a polymeric anode is dependent on the concentration and homogeneity of EB present in the nanocomposite film. Furthermore we have demonstrated the addition of the dye-nanoparticle dispersion directly into the anode polymeric matrix results in greater stability of the electron transfer process. Much development is necessary before the long-term goal of producing a flexible, complete DSSC is accomplished; anodic optimization and cathode development are in progress. The flexibility, low cost and ease of preparation of the EB-PVA polymer film creates great possibilities for widespread application and maximized efficiency of DSSCs.