

# Copper-Based Aqueous Dye-Sensitized Solar Cell: Seeking a Sustainable and Long-Term Stable Device

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Aqueous dye-sensitized solar cells (a-DSSCs) have emerged as a promising option for safe, cost-effective, and environmentally friendly photovoltaic technology. Unlike conventional organic-based DSSCs, a-DSSCs utilize water as a greener and safer electrolyte solvent. This study introduces for the first time the use of N-methylbenzimidazolium acetate (HNMBI+OAc-) along with a water-soluble copper redox-couple [bis(6,6'-dimethyl-2,2'-bipyridine) copper (I/II) acetate] in a-DSSCs. The study delves into the electrochemical properties of different electrolyte compositions, highlighting the significance of the employed HNMBI+OAc- additive in providing free N-methylbenzimidazole Lewis base in the medium that in turn enhances the performance of the a-DSSCs by mitigating electron recombination processes and possibly improving dye regeneration. Furthermore, the optimized and tested a-DSSCs exhibited remarkable stability when exposed to constant ambient light irradiations for one year, or to high temperatures (52 °C) for 1000 h in the dark, marking successful progress toward sustainable and durable photovoltaic devices. © 2024 The Authors. Published by American Chemical Society.