Förster Resonant Energy Transfer at the Interface of Photoanode and Electrolyte in Dye-sensitized Solar Cells Employing DCJTB as Energy Relay Dye

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Since 1991, Dye-sensitized solar cells (DSSCs) have attracted much attention of researchers. A lot of study has been done to improve their photovoltaic performance. Recent studies revealed that using energy relay dyes (ERDs) to transfer energy to the traditional dye as N3 through Förster resonant energy transfer (FRET) is an effective method to increase their photoresponse range.

Now ERDs used in DSCs mainly disperse in electrolyte solution. However, in such condition many ERD molecules are far away from the acceptor dye attached on the TiO₂ surface, weakened the effects of FRET from the ERDs to acceptors. Furthermore, the solvent of electrolyte could cause the ERDs elicitation quenching.

In our work, DCJTB is employed as ERD in the N3 dye based DSSCs. As shown in Fig. 1(a), the emission peak of DCJTB differed from the adsorption peak of N3 in the solution, which is 620 nm and 530 nm, respectively. However, Fig.1 (b) reveals that it shifted to 560 nm on the TiO₂ film, which is the same situation in the DSSCs devices as using the dip-coating method to concentrate ERD at the interface of photoanode and electrolyte. As a result, the emission peak of ERD almost overlaps the adsorption peak.

Furthermore, the distance of ERD and acceptor has been shortened via the dip-coating method. Then the efficiency of FRET is improved subsequently. Fig. 2 illustrated the FRET between DCJTB and N3. Accordingly, the conversion efficiency of DSSCs could be improved due to the enhanced photoresponse based on FRET.