How does back reaction at the conducting glass substrate influence the dynamic photovoltage response of nanocrystalline dye-sensitized solar cells?

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The role of the conducting glass substrate (fluorine-doped tin oxide: FTO) in the back reaction of electrons with tri-iodide ions in dye-sensitized nanocrystalline solar cells (DSC) has been investigated using thin layer electrochemical cells that are analogs of the DSC. The rate of back reaction depends on the type of FTO and on thermal treatment. The results show that the back reaction route cannot be neglected in DSC, particularly at lower light intensities where it is the dominant route for the back transfer of electrons to tri-iodide. This conclusion is confirmed by measurements of the intensity dependence of the photovoltages of DSCs with and without blocking layers. It follows that blocking layers should be used to prevent the back reaction in mechanistic studies in which the light intensity is varied over a wide range. Conclusions based on studies of the intensity dependence of the parameters of DSCs such as photovoltage and electron lifetime in cells without blocking layers need to be re-examined.

Figure 1 shows how even small current densities at the substrate distort the intensity dependence of the photovoltage. **Figure 2** shows how the open circuit photovoltage decay is affected by j_0. **Figure 3** shows how the intensity dependence of the electron lifetime is also grossly distorted even if j_0 is very small. **Figure 4** contrasts the experimentally determined values of electron lifetimes fro cells fabricated with and without TiO_2 blocking layers to suppress back reaction at the substrate.

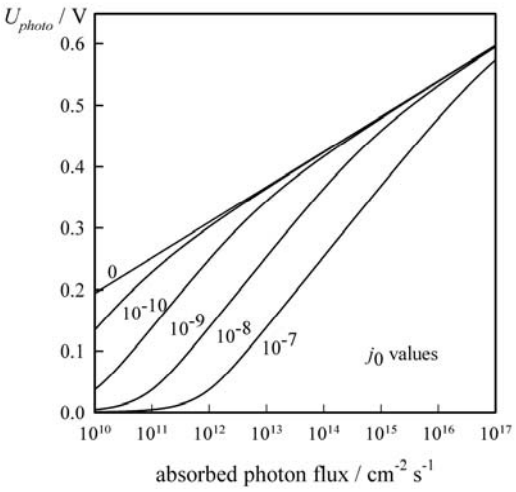

Figure 1

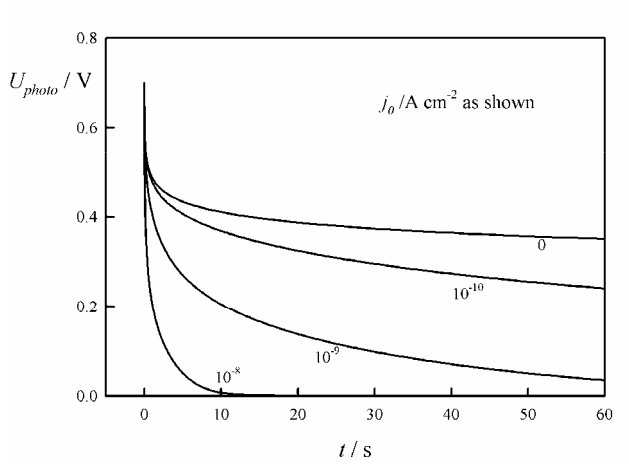

Figure 2

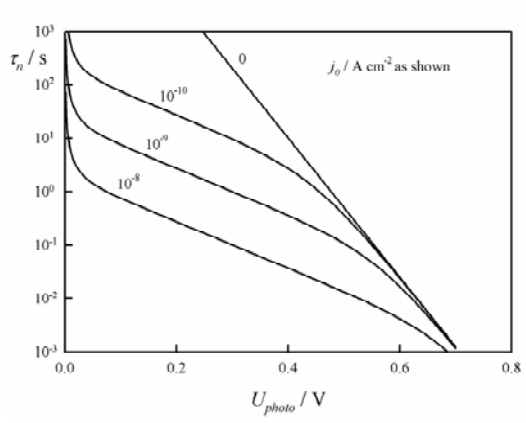

Figure 3

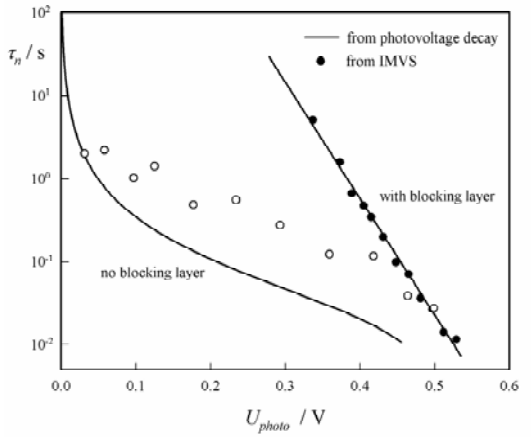

Figure 4

References.

P.J. Cameron and LM Peter. J. Phys Chem. B (in press).

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