

A Photoemission Study of Dye Molecules Deposited by Electrospray on rutile TiO₂ (110)

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Abstract : For decades, renewable energy sources have received considerable global interest due to the increase in fossil fuel consumption. The abundant energy produced by sunlight makes dye-sensitised solar cells (DSSCs) a promising alternative compared to conventional silicon and thin film solar cells due to their transparency and tunable colours, which make them suitable for applications such as windows and glass facades. The transfer of an excited electron onto the surface is an important procedure in the DSSC system, so different groups of dye molecules were studied on the rutile TiO₂ (110) surface. Currently, the study of organic dyes has become an interest of researchers due to ruthenium being a rare and expensive metal, and metal-free organic dyes have many features, such as high molar extinction coefficients, low manufacturing costs, and ease of structural modification and synthesis. There are, of course, some groups that have developed organic dyes and exhibited lower light-harvesting efficiency ranging between 4% and 8%. Since most dye molecules are complicated or fragile to be deposited by thermal evaporation or sublimation in the ultra-high vacuum (UHV), all dyes (i.e. D5, SC4, and R6) in this study were deposited in situ using the electrospray deposition technique combined with X-ray photoelectron spectroscopy (XPS) as an alternative method to obtain high-quality monolayers of titanium dioxide. These organic molecules adsorbed onto rutile TiO₂ (110) are explored by XPS, which can be used to obtain element-specific information on the chemical structure and study bonding and interaction sites on the surface.

Keywords : dyes, deposition, electrospray, molecules, organic, rutile, sensitised, XPS

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