Design of mesoporous hybrid titania for solar light harvesting using coordination transition metal complexes as building blocks

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The quest for materials able to efficiently harvest solar light has become one of the biggest challenges of our time. Titania (TiO_2) is one of the most widely used materials in light harvesting systems, despite having a large band-gap (of about 3.0 eV), which only uses ca. 5% of the solar radiation (U.V.). Based on a versatile approach that we have recently developed, namely "Sol-Gel Coordination Chemistry",[1] we have prepared the first hybrid organo-titanias, with efficient incorporation of organic moieties into the structure of the titania.[2] These materials showed a very significant reduction of its band gap (up to 2.74 eV) and revealed highly active and remarkably stable photocatalytic properties.

Building on this strategy, herein we communicate the one-pot co-condensation of tetrabutyl orthotitanate (TBOT) and the neutral Ru(II) N3 dye or the new cationic Ir(III) complex $[Ir(ppy)_2(3,3'\text{-}H_2dcbpy)]PF_6$, which yields titanias containing the coordination chromophores not only on the surface but also within the network (Figure 1). These complexes act both as defects (or disruptors) of the crystalline structure of the anatase (narrowing its band gap) and as dyes (molecular antenna). The novel hybrid metal complex-titania materials have been tested for the degradation of rhodamine 6G under UV or visible light and have bee also used as part of the anode architecture of new low temperature sintered dye-sensitized solar cells (lt-DSSCs). In both cases, the new materials show a superior activity and stability when compared to related conventional dye-sensitized titania prepared by grafting. The incorporation of dyes the crystalline structure is a promising alternative route to prepare dye-sensitized materials.

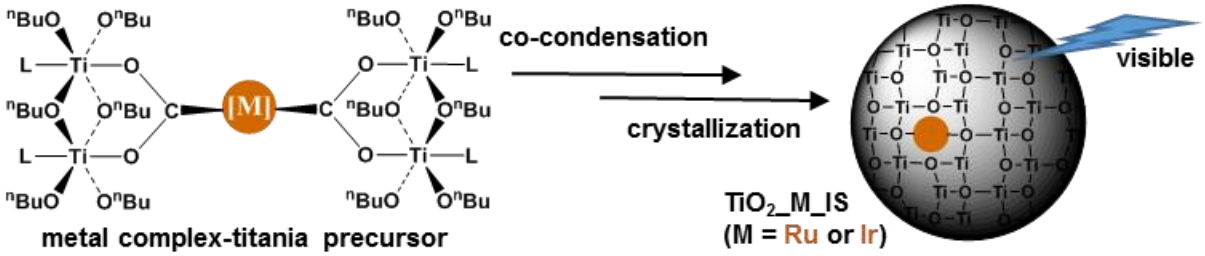

Fig. 1 Scheme of the procedure that has been used to incorporate different metal complexes into the structure of titania. This methodology is based on a strategy previously described for the preparation of hybrid silica materials. [1]

References

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