Nanotechnology for solar energy conversion systems

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EU researchers extensively characterised the self-organisation of nanotubes and developed novel compositions particularly appropriate to solar energy conversion applications.

Self-organized one-dimensional (1D) oxide nanotube systems are a hot research topic of late given that their inherently high surface area-to-volume ratio produces interesting and useful properties.

In particular, over the last 20 years, ordered arrays of porous titanium oxide (TiO_2), or TiO_2 nanotubes, achieved via electrochemical anodisation have been extensively studied. To date, TiO_2 is the only material suitable for use as a photocatalyst (substance using light energy to enhance chemical reactions) due to its high efficiency and stability, low cost and safety profile toward humans and the environment.

European researchers set out to prepare and characterise self-organised TiO_2 nanotubes with an ordered structure similar to that of porous aluminium oxide (Al_2O_3) and silicon (Si) nanotubes via funding of the 'Preparation, characterisation and application of self-organised titanium oxide - nanotubes' (TI- Nanotubes) project.

In particular, investigators sought to understand key parameters governing self-organisation of TiO_2 nanotubes, specifically those affecting tube dimensions, orientation and morphology. The ultimate goal was to develop novel functional and structural materials with superior performance characteristics to be used in solar energy

conversion systems such as dye-sensitised solar cells.

Self-ordering mechanisms of TiO2 nanotubes were investigated via a plethora of surface analysis technologies including Rutherford backscattering spectrometry (RBS) and nuclear reaction analysis (NRA) for depth profiling.

The TI- Nanotubes consortium successfully produced TiO2 nanotube arrays doped with silver (Ag) or iron (Fe) that exhibited enhanced photocatalytic activity important for solar energy conversion applications.

Commercial exploitation of TI- Nanotubes project results has the potential to enhance solar energy efficiency and use with important benefits for the EU economy, EU citizens and the planet.

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