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Perspective

Pseudohalide Anions of Nano-Sized TiO_2 in Pharmaceutical Additives

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DESCRIPTION

The pseudo-halogens are the polyatomic analogues of halogens, which resemble the true halogens, which involve in substitution of halogens in several classes of chemical compounds. They occur in pseudohalogen molecules, inorganic molecules of the general forms Ps–Ps or Ps–X such as cyanogen; pseudohalide anions, such as cyanide ion; inorganic acids, such as hydrogen cyanide; as ligands in the co-ordination complexes, such as ferricyanide; and the functional groups in organic molecules, such as the nitrile group. The well-known pseudohalogen functional group involves cyanide, cyanate, thiocyanate, and azide.

Titanium dioxide (titania, TiO_2) is chemically inert, semiconducting material that also exhibits photo-catalytic activity in the presence of light with an energy equal to or higher than its band-gap energy. The preparation and characterization of two pseudohalogen redox couples for dye - sensitized TiO_2 photo-electrochemical cells. The equilibrium potentials of the $(SCN)_2$/SCN- couples are respectively 0.19 and 0.43 V more positive than for the I_3-/I- couple, providing the opportunity to determine the influence of the redox potential on the open circuit photo-voltage.

With the sensitizer cis-$Ru(dcb)_2(NCS)_2$ (N_3), the incident photon-to-current conversion efficiency was 20% for the $(SeCN)_2$/SeCN- couple and 4% for the $(SCN)_2$/SCN- couple. The transient absorbance of measurements shows the quantum yield for electron injection which is independent for the pseudohalogen redox couple and the regeneration rates of the dye decrease in the order I- > SeCN- > SCN-. The effects of the redox potential on open circuit photo-voltage were determined by independent measurement of the dependence of the sensitized TiO_2 working electrode and the platinum counter electrode potentials.

Titanium dioxide (TiO_2) is the most investigated semiconductor in photocatalysis, but the photo-catalytic performance can be further improved by rational design of the material as nanostructure with special surface and structural properties. The methods for site-selective decoration of anodic TiO_2 nanotube (NT) arrays, particularly to introduce stable defects and investigate the mechanism for enhanced activity and stability of these noble metal–free photocatalysts. The investigated methods include proton implantation and nitrogen implantation into the TiO_2 NTs and decoration of alternative co-catalysts (e.g., molybdenum - based co-catalysts). Such modifications on TiO_2 NT layers leads to creation of efficient photocatalysts for H_2 evolution, which is synergistic effect of light harvesting by TiO_2 NTs coupled with co-catalytic centers of the tube layers. These described methods for selective decoration of TiO_2 NTs can be further extended and potentially applied to the activation of a range of One-Dimensional (1D) semiconductor materials.

Nano-sized TiO_2 is widely used in everyday life in the form of products, such as anti-fouling paints, household products, plastic goods, medications, cosmetics, sunscreens, pharmaceutical additives and food colorants, and many new applications are under development or in pilot production.

The average size of the TiO_2 particles in sun-screens ranges between 10 and 100 nm, while some products contain particles down to 5 nm or up to 500 nm.TiO_2 particles are in the range of between 200 and 500 nm opaque and act as a true sun-block when applied to the skin. However, it is lost when much finer particles are used. Therefore, the optimum size of TiO_2 particles was suggested to be around 50 nm, which provides good protection against Ultra Violet (UV) light, while the dispersion of visible light is such that sunscreens do not appear white on the skin.

CONCLUSION

TiO_2 has been well accepted in the food industry and found at "E171" additive in various food products, mainly for whitening and texture. It is present in Mozzarella cheeses, horseradish cream and sauces, lemon curd, and in low-fat products such as skimmed milk and ice-cream. The product containing "E171", has no information that is usually given for the quantity, particle size and particle structure. FDA claims that TiO_2 may be safely used as a color additive for coloring foods in quantities up to 1% by weight of the food. TiO_2 is frequently declared as "natural coloring agent" and is therefore well accepted by consumers.

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