Section E2

Engineered Nanomaterials from Mineral Resources: Applications in Industry & Environment

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Introduction

Nanotechnology has attracted considerable scientific interest due to the new potential uses of particles in 1-100 nanometer scale (Stone *et al.*, 2010). At the nanoscale, physical, chemical, and biological properties differ from the properties of individual atoms and molecules of bulk matter. Therefore, it provides an opportunity to develop new classes of advanced materials which meet the demands of high-tech applications (Kharisov *et al.*, 2010). Thus, industries may be able to re-engineer many existing products that function at unprecedented levels. Globally, nanotechnology is projected to be an all pervasive technology. Nanotechnology is estimated to make a great impact on the global economy. The world market for nanotechnological products by 2015 was around US$ 3 trillion. A quickly growing range of applications of nanomaterials in many fields has been observed in recent years. Among them, nano titanium dioxide (nano-TiO_2), nano carbon, nanographite, graphene, carbon nanotube, nanoclay and nanosilica are widely used nanomaterials with a wide spectrum of industrial and environmental applications.

Nano titanium dioxide (nano-TiO_2) from ilmenite

As a new material, nano-sized TiO_2 has been of great interest to many scientists in the recent years. Its small size and large specific surface area allow for certain unique unusual physicochemical properties. Nano-TiO_2 has the tightly controlled particle size that increases both the refractive index and light scattering properties as a result of the uniform particle size distribution and additional surface area. Due to the higher photocatalytic activity, nano-TiO_2 can be used in anti-fogging coatings, where nano-TiO_2 incorporated into outdoor building materials can substantially reduce concentrations of airborne pollutants such as volatile organic compounds and nitrogen oxides and as photocatalyst coating which assist in deactivation of bio-contaminants. Recently, a large number of studies were reported, based on the photocatalytic activity of TiO_2 for oxidation of organic chemicals, obviously the most potential environmental friendly process. In general, two methods of application of TiO_2 in photocatalysis have emerged, one as highly dispersed fine particles on porous support materials and suspended fluids in liquid medium, and another as their films (Sonawa *et al.*, 2002).

Sri Lanka has vast deposits of ilmenite ($FeTiO_3$) which is the major raw material for titanium dioxide (TiO_2) pigment production. Major concentrated deposits are located along the 72 km North-East coastal stretch of Sri Lanka. It has been estimated that the North-East coast contains 8-9 million tons of ilmenite and 1.0 million tons of rutile. The beach sand deposits in the North- East coast at Pulmoddai are very high grade, with a heavy mineral content of 80% and a composition of 70-72% ilmenite ($FeTiO_3$), 8% rutile (TiO_2) and 8-10% zircon ($ZrSiO_4$). The present plant has a capacity of