[0005] The need exists for improved methods for producing novel types of rutile titanium dioxide (TiO_2) nanoparticles which have high surface areas, e.g., in the range of from 120 m^2/g to 160 m^2/g, and high refractive indices for improved UV blocking capability and which demonstrate high performance levels in catalysis, e.g., biomass conversion, and in electronic applications, such as lithium ion batteries and fuel cells.

SUMMARY OF THE INVENTION

[0006] The described and claimed inventive concepts(s) comprise in one embodiment a method for preparing a novel form of rutile TiO_2 nanoparticles which are ordered acicular aggregates of elongated TiO_2 crystallites. The elongated TiO_2 crystallites are rod-like, e.g., slender and/or needle-like, having a thickness of from 3 nm to 5 nm and a length which can vary from 20 nm up to 50 nm, although longer and shorter lengths may also be present. However, the elongated TiO_2 crystallites assemble together during the process in a manner which results in ordered acicular aggregates that resemble nano-sized flower bouquets or triangular funnels. The largest dimension of the funnel-shaped nano-particles is about 100 nm.

[0007] The method comprises:

(a) forming an aqueous solution of a soluble titanium compound at a titanium concentration of from 0.1 to 1.5 moles per liter, although a concentration range of from 0.5 to 1.0 moles per liter is preferred, optionally in the presence of a mineral acid;

(b) introducing a morphology controlling agent, or a mixture thereof, selected from an α-hydroxy carboxylic acid of the formula R-CH(OH)COOH, an α-hydroxy carboxamide of the formula R-CH(OH)$CONH_2$, or an α-amino acid of the formula RCH(NH_2)COOH, wherein R is an alkane, alkene, alkyne, arene, or cycloalkane group having 6 or more carbon atoms, into the solution at an acid- or carboxamide-to-titanium molar ratio of from 0.02 to 0.2 while simultaneously heating the solution to a temperature in the range of from 60°C to 80°C with constant stirring;

(c) introducing TiO_2 seeds into the stirred solution at a seed-to-TiO_2 molar ratio of from 0.0005 to 0.0015 and maintaining the stirred solution at a temperature in the range of from 60°C to 80°C for a period of from one to 3 hours;