There is therefore a need to provide alternative methods for preparing silica nanoparticles that addresses the above problems or achieves the desired properties, geometry or morphology. In particular, there is a need to provide an alternative method for producing silica nanoparticles, which is non-complex and which can be carried out under mild conditions.

Summary of Invention

There is provided a method of forming silica nanoparticles in an aqueous medium, the method comprising steps of (a) providing a surfactant solution comprising a cationic surfactant in an aqueous medium; and (b) mixing a silane source with the surfactant solution from step (a) under pH conditions of about pH 5 to 8 for forming said silica nanoparticles.

According to a first aspect, there is provided a method of forming silica nanoparticles in an aqueous medium, the method comprising steps of: (a) providing a surfactant solution comprising a cationic surfactant in the aqueous medium; and (b) mixing a silane source with the surfactant solution from step (a) under pH conditions of about pH 5 to 8 for forming said silica nanoparticles, wherein said cationic surfactant is a quaternary ammonium salt comprising at least two independently selected C_6-C_{22} alkyl groups and covalently bonded to the positively charged nitrogen atom; and wherein said quaternary ammonium salt has a counter-ion selected from acetate, carbonate, oxalate, phosphate, chloride or bromide, and wherein step (b) is performed at a temperature of between about 0 °C to about 25 °C.

The disclosed method may be characterized by the use of a single cationic surfactant for formation of the silica nanoparticles. Advantageously, the use of non-ionic surfactants may be avoided. Accordingly, in embodiments, the surfactant solution may consist essentially of a cationic surfactant as described herein.

Advantageously, the method may be performed in a substantially aqueous environment, rendering the method environmentally friendly. This may simplify the process of isolating or extracting the silica nanoparticles once formed. Steps associated with organic solvent separation and/or disposal are advantageously avoided. Also, the disclosed method is straightforward in that it requires relatively few reactants or additives. The disclosed method may be a single step, one-pot aqueous reaction. The disclosed method may be performed without pH variation or at substantially the same pH condition throughout. For instance, the addition of an acid or a basic medium is optional, unlike conventional sol-gel synthesis method which require

acid hydrolysis. As a result, the disclosed method may result in less waste being generated.

The mild pH conditions of about pH 5 to 8 during the mixing step allows the preparation of the silica nanoparticles to be carried out in a safe and simple manner. Advantageously, the disclosed method avoids or eliminates the requirement for expensive processing equipment designed to be resistant to acidic and/or basic environments, which makes it easier to scale up for industrial processes.

The disclosed method may surprisingly be capable of forming three-dimensional silica nanoparticles such as hexagonal platelets, spheres or torus-like particles.

Advantageously, these three-dimensional silica nanoparticles may be substantially uniform in size or monodispersed. Advantageously, the hexagonal silica platelets may be useful for deploying the disclosed silica particles as deposition aids, substrates for array formation, as a clotting material, etc. Furthermore, the hexagonal silica platelets may be highly scattering in the UV/VIS spectral region and may be advantageously used as cosmetic whitening agents or as pigments in UV blocking/absorption compositions,

There is provided a silica suspension comprising a plurality of hexagonally shaped silica platelets, said platelets being substantially monodisperse and having a width dimension from around 50 to 1000 nm, said platelets being suspended in an aqueous medium, wherein said aqueous medium comprises a single type cationic surfactant. According to another aspect, there is provided a silica suspension comprising a plurality of hexagonally shaped silica platelets, said platelets being substantially monodisperse and having a width dimension from around 50 to 2000 nm, said platelets being suspended in an aqueous medium, wherein said aqueous medium comprises a single type of cationic surfactant, wherein the silica platelets does not have a mesoporous structure. The silica platelets may be prepared in accordance with the methods disclosed herein.

There is provided a silica nanoparticles prepared by reacting a silane source with a volumetric excess of a surfactant under pH of about 5 to about 8 in the presence of an aqueous solvent.

In a further aspect, there is provided a hexagonally shaped silica nanoparticle having a width dimension from around 50 to 2000 nm, wherein the nanoparticle does not have a mesoporous structure.

There is provided a silica nanoparticles obtainable by a method as disclosed herein. In yet another aspect, there is provided a silica nanoparticle obtainable by a method as disclosed herein, wherein the nanoparticle is hexagonally shaped and does not have a mesoporous structure.

In another aspect, there is provided a cosmetic composition comprising a silica suspension or silica nanoparticles as disclosed herein.

In a further aspect, there is provided a method of providing UV shielding properties to a composition, comprising adding a silica suspension or silica nanoparticles as disclosed herein to said composition.

Definitions

The following words and terms used herein shall have the meaning indicated:

As used herein, the expression “silica nanoparticles” is to be interpreted broadly to include three-dimensional silica particles which may be but not limited to hexagonal platelets, spheres, torus-like particles. These silica particles may be less than 2000 nm in at least one of the dimensions selected from the thickness, length, width or diameter. In the case of torus-like particles, the diameter may refer to the longest distance traversing the outermost circumference of the particle. Throughout the