
**Preparation of a titanium silicate having the RUT
structure**

The present invention relates to a process for preparing a titanium silicate having the RUT structure and its use as catalyst and also to a process for reacting organic compounds with the aid of this catalyst.

Silicates as salts of the silicic acids are usually in the form of uniformly structured, spatially limited acyclic or cyclic silicate anions or spatially infinite silicate ions which are joined by means of associated metal cations to form larger complexes. Examples of structures of these spatially infinite silicate anions are chain, band, sheet and framework structures.

An important group of framework silicates are the zeolites. The three-dimensional network of these zeolites is built up of SiO_4 tetrahedra which are joined to one another via shared oxygen bridges. The zeolites, i.e. aluminosilicates, have ordered channel and cage structures. The pore openings occurring here are in the size range of >0.9 nm. An overview of the various known structures of aluminosilicates may be found, for example, in M.W. Meier, D. H. Olson and C. Baerlocher, "Atlas of Zeolite Structure Types", 4th Edition, Elsevier, 1996.

Apart from the aluminosilicates, materials in which titanium is present in place of silicon in the silicate lattice are also known. Among these compounds, particular mention may be made of titanium-containing silicate having the MFI structure type. Such a silicate is disclosed, for example, in US-A-4,410,501.

Titanium silicates having the MFI structure are typically obtained by first preparing an aqueous mixture of an SiO₂ source and a titanium source. This mixture is then reacted in a pressure vessel in the presence of a template compound. This process is described, for example, in US-A-4,666,692.

The present invention provides a process for preparing a titanium silicate having the RUT structure, which comprises the steps (i) and (ii):

- (i) preparation of a mixture comprising at least one SiO₂ source and at least one titanium source;
- (ii) crystallization of the mixture from (i) in a pressure vessel with addition of at least one template compound to give a crystallization product,

wherein the template compounds used are amines or ammonium salts which are suitable for stabilizing cages of the silicate structure [4⁴5⁴6²] and [4⁴5⁶6⁵8¹].

The present invention likewise provides the titanium silicate having the RUT structure itself, able to be prepared by a process which comprises the steps (i) and (ii):

- (i) preparation of a mixture comprising at least one SiO₂ source and at least one titanium source;
- (ii) crystallization of the mixture from (i) in a pressure vessel with addition of at least one template compound to give a crystallization product,

wherein the template compounds used are amines or ammonium salts which are suitable for stabilizing cages of the silicate structure [4⁴5⁴6²] and [4⁴5⁶6⁵8¹].

As SiO₂ source in the abovementioned process, use is made, in particular, of esters of orthosilicic acid. Preference is given to using tetraesters. Tetraethyl orthosilicate is particularly preferably used in the process of the present invention.

As titanium source in the process of the present invention, it is possible to use, for example, titanium dioxide. However, preference is given to using titanates, particularly preferably orthotitanates and in particular tetraisopropyl orthotitanate.

It is of course possible to use two or more suitable SiO₂ sources and/or two or more suitable titanium sources in the process of the present invention.

In the process of the present invention, a mixture is prepared from the SiO₂ source or sources and the titanium source or sources. Particular preference is given to using an aqueous mixture of these components. The order in which the components are mixed is not critical. The way in which the components are mixed with one another is likewise not critical. All methods and apparatuses known from the prior art, e.g. blade stirrers, can be used for this purpose.

In the process of the present invention, a template compound as described above is added to the above-described mixture. This template compound is preferably added in an aqueous solution to the above-described mixture. In general, the concentration of this solution of template compound can be chosen freely. However, it preferably has a content of template compound in the range from 1 to 25% by weight, particularly preferably in the range from 2 to 15% by weight and in particular in the range from 3 to 8% by weight.

Examples of such template compounds are tetramethylammonium hydroxide or pyrrolidine.

5 In addition to the template compound, one or more further basic compounds, e.g. hydroxides of ammonium salts, can be added to the abovementioned mixture of the SiO_2 source or sources and the titanium source or sources in the process of the present invention.

10 The alkali metal or alkaline earth metal content of the suspension obtained from step (ii) in the process of the present invention is generally < 1000 ppm, preferably < 500 ppm and particularly preferably < 200 ppm.

15

Depending on the SiO_2 and/or titanium sources, the preparation of the mixture as described above may result in formation of an alcohol by hydrolysis. This is generally distilled from the mixture at from 90 to 20 100°C, but can also remain in the mixture. The residue is transferred to a pressure vessel. If the starting materials are chosen so that no distillation is necessary, the mixture comprising the SiO_2 source or sources and the titanium source or sources can be 25 transferred immediately to the pressure vessel.

The mixture is reacted in the pressure vessel at a reaction temperature which is generally in the range from 80 to 300°C, preferably from 120 to 250°C, 30 particularly preferably from 150 to 220°C. The reaction time here is generally in the range from 3 to 15 days, preferably in the range from 6 to 13 days, particularly preferably in the range from 8 to 11 days.

35 After the reaction is complete, the crystalline product resulting from the reaction can be separated from the liquid phase by all customary methods of the prior art. Depending on the application for which the product is

intended, it may be necessary to wash it one or more times with water. The solid obtained is dried in the process of the present invention. Here too, use can be made of all customary methods of the prior art. For
5 example, the solid obtained can be dried in an oven suitable for this purpose at temperatures in the range from 105 to 115°C. The drying time is generally from 5 to 20 hours, preferably from 7 to 15 hours.

10 Naturally, spray drying the crystalline product as described above, which is present in suspension in the liquid phase, in at least one spray-drying step is also conceivable.

15 To remove the template compound added in step (ii) and any further basic compounds, the crystalline product is calcined at least once subsequent to drying.

The temperatures selected in the calcination or
20 calcinations are generally in the range from 120 to 850°C, preferably from 180 to 700°C, particularly preferably from 250 to 550°C. Calcination is generally carried out in an oxygen-containing atmosphere in which the oxygen content is from 0.1 to 90% by volume,
25 preferably from 0.2 to 22% by volume, particularly preferably from 0.2 to 10% by volume. The pressure selected for the calcination is generally in the range from 0.01 to 5 bar, preferably from 0.05 to 1.5 bar.

30 Accordingly, the present invention also provides a process for preparing a titanium silicate having the RUT structure which comprises, in addition to the steps (i) and (ii) as described above, the steps (iii) and (iv):

35 (iii) drying of the crystallization product resulting from (ii);

(iv) calcination of the dried product from (iii).

To prepare the titanium silicate having the RUT structure by the process of the present invention, as described above, the concentrations of the SiO_2 source or sources and the titanium source or sources for preparing the mixture as described in step (i) are selected so that the crystalline product resulting from step (ii) or (iv) has a titanium concentration which is generally in the range from 0.001 to 5% by weight. However, the titanium concentrations in the titanium silicate having the RUT structure are preferably selected so as to be in the range from 0.002 to 1% by weight, particularly preferably from 0.003 to 0.5% by weight, more particularly preferably from 0.004 to 0.1% by weight, very particularly preferably from 0.005 to 0.05% by weight and most preferably about 0.01% by weight.

Accordingly, the present invention also provides a titanium silicate having the RUT structure whose titanium content is in the range from 0.001 to 5% by weight.

Here, these figures for the titanium content are based on results obtained from wet chemical analysis.

The present invention also provides a titanium silicate having the RUT structure which displays at least the following reflections in the X-ray diffraction pattern:

Diffraction angle 2θ	Lattice plane spacing d (0.1 nm)
10.79	8.19
13.69	6.45
14.48	6.10
20.19	4.49
22.16	4.00
23.26	3.82
27.45	3.24

A further characteristic which distinguishes titanium-containing zeolites from zeolites which do not contain
5 titanium is a specific lattice vibration band in the IR spectrum (DE 3047798). Accordingly, the present invention also provides a titanium silicate having the RUT structure which displays a band in the range from 955 to 970 cm^{-1} in the IR spectrum.

10

Titanium zeolites having the MFI structure are known to be suitable as catalysts for the reaction of organic compounds. This is disclosed, for example, in
B. Notari, Stud. Surf. Sci. Catal., Vol. 37, Amsterdam,
15 pages 413 to 425 (1987). The titanium silicates of the present invention having the RUT structure have also been found to be suitable as catalysts.

The present invention therefore also provides for the
20 use of a titanium silicate as defined herein as catalyst.

For use of the titanium silicate of the present invention having the RUT structure as catalyst,
25 particularly mention may be made of processes in which

organic compounds are reacted. The present invention therefore also provides a process for the reaction of an organic compound in which the organic compound is brought into contact with a catalyst according to the
5 present invention, as described above, during the reaction.

In particular, the present invention also relates to a process in which the organic compound is oxidized
10 during the reaction.

Examples of reactions are:

the epoxidation of olefins, e.g. the preparation of
15 propene oxide from propene and H_2O_2 or from propene and mixtures which provide H_2O_2 in situ;

hydroxylations, e.g. the hydroxylation of monocyclic, bicyclic or polycyclic aromatics to form
20 monosubstituted, disubstituted or higher-substituted hydroxyaromatics, for example the reaction of phenol and H_2O_2 or of phenol and mixtures which provide H_2O_2 in situ to form hydroquinone;

25 the conversion of alkanes into alcohols, aldehydes and acids;

oxime formation from ketones in the presence of H_2O_2 or mixtures which provide H_2O_2 in situ and ammonia
30 (ammonoximation), for example the preparation of cyclohexanone oxime from cyclohexanone;

isomerization reactions, e.g. the conversion of epoxides into aldehydes;

and also further reactions described in the literature,
as are described, for example, by W. Hölderich in
"Zeolites: Catalysts for the Synthesis of Organic
5 Compounds", Elsevier, Stud. Surf. Sci. Catal., 49,
Amsterdam (1989), p. 69 to 93 and particularly for
possible oxidation reactions by B. Notari in Stud.
Surf. Sci. Catal., 37 (1987), pp. 413 to 425, or in
Advances in Catalysis, Vol. 41, Academic Press (1996),
10 pp. 253 to 334.

The term "mixture which provides H_2O_2 in situ" as used
for the purposes of the present invention means that
this mixture, which can consist of two or more
15 different compounds, is combined in a single-vessel
reaction with at least one compound which is to be
reacted with H_2O_2 and the H_2O_2 formed from the mixture
reacts either at the time it is formed or at a later
point in time with the compound or compounds to be
20 reacted.

Depending on the type of process in which the titanium
silicate of the present invention having the RUT
structure is used as catalyst, the silicate is used
25 either as powder or as shaped bodies.

When the catalyst is used as powder, recourse can be
made directly to the crystalline product which results
from the process of the present invention, as described
30 above.

If the crystalline product is shaped to form a shaped
body, it is possible to employ, for example, the dried
crystalline product from the above-described step
35 (iii).

The product obtained, for example, from a spray-drying step is compacted to produce the shaped body in a further step of the process of the present invention. This processing step can be carried out in all
5 apparatuses known for this purpose, but preference is given to kneaders, pan mills or extruders. For industrial implementation of the process of the present invention, particular preference is given to using a pan mill.

10

In this shaping step, one or more viscosity-increasing substances can be additionally added as pasting agents. All suitable substances known from the prior art can be used for this purpose. In the process of the present
15 invention, preference is given to using water or mixtures of water with one or more organic substances which are miscible with water as pasting agents. The pasting agent can be removed again during the later calcination of the shaped body.

20

Preference is given to using organic, in particular hydrophilic organic, polymers such as cellulose, cellulose derivatives such as methylcellulose, polyvinylpyrrolidone, ammonium (meth)acrylates, Tylose,
25 particularly preferably methylcellulose.

As further additives, it is possible to add ammonium, amines or amine-like compounds such as tetraalkylammonium compounds or aminoalkoxides. Such
30 further additives are described in EP-A 0389041, EP-A 02002660 and WO 95/19222, the full scope of which is incorporated by reference into the present application.

Instead of basic additives, it is also possible to use
35 acidic additives. Preference is given to acidic organic compounds which can be burnt out by calcination after

the shaping step. Particular preference is given to carboxylic acids.

To influence properties of the shaped body, it is possible to add further substances, preferably organic compounds, in particular organic polymers, as further additives which can also influence the formability of the composition. Such additives are, inter alia, alginates, polyvinylpyrrolidones, starch, cellulose, polyethers, polyesters, polyamides, polyacrylates, polymethacrylates, polyethylenimines or polyetherols.

Of course, it is also possible for mixtures of two or more of the abovementioned additives to be incorporated.

The order in which the additives are added is not critical.

If desired, the generally still pulverulent mixture can be homogenized for from 10 to 180 minutes in a kneader or extruder prior to compaction. This is generally carried out at temperatures in the range from about 10°C to the boiling point of the pasting agent and at atmospheric pressure or slightly superatmospheric pressure. The mixture is kneaded until an extrudable composition has been formed.

In principle, kneading and shaping can be carried out using all conventional kneading and shaping apparatuses or processes as are well known from the prior art and are suitable, for example, for the production of shaped catalyst bodies.

Preference is given to using processes in which shaping occurs in customary extruders to form, for example,

extrudates having a diameter of usually from about 1 to about 10 mm, in particular from about 1.5 to about 5 mm. Such extrusion apparatuses are described, for example, in "Ullmanns Enzyklopädie der Technischen Chemie", 4th Edition, Volume 2 (1972), p. 295 ff. Apart from the use of an extruder, the use of a ram extruder is also preferred. In the case of industrial application of the process, preference is given to using extruders.

10

The extrudates are either rods or honeycombs. The honeycombs can be of any shape. The extrudates can be, for example, round rods, tubes or star-shaped profiles. The honeycombs can also have any diameter. The external shape and the diameters are generally decided by the process engineering requirements which are determined by the process in which the shaped body is to be used.

Before, during or after the shaping step, noble metals in the form of suitable noble metal components, for example in the form of water-soluble salts, can be applied to the material. This preferably gives catalysts containing from 0.01 to 30% by weight of one or more noble metals selected from the group consisting of ruthenium, rhodium, palladium, osmium, iridium, platinum, rhenium, gold and silver.

However, in many cases it is most useful to apply the noble metal components to the shaped bodies after the shaping step, particularly when high-temperature treatment of the noble metal-containing catalyst is undesirable. The noble metal components can be applied to the shaped body by, in particular, ion exchange, impregnation or spraying. They can be applied by means of organic solvents, aqueous ammoniacal solutions or supercritical phases such as carbon dioxide.

The use of the abovementioned methods enables a wide variety of types of noble metal catalysts to be produced. Thus, one type of coated catalyst can be produced by spraying the noble metal solution onto the
5 shaped bodies. The thickness of this noble metal-containing shell can be significantly increased by impregnation, while ion exchange results in virtually uniform distribution of noble metal across the cross section of the catalyst particles.

10

After extrusion has been carried out, the shaped bodies obtained are dried at generally from 50 to 250°C, preferably from 80 to 250°C, at pressures of generally from 0.01 to 5 bar, preferably from 0.05 to 1.5 bar,
15 for from about 1 to 20 hours.

The subsequent calcination is carried out at from 250 to 800°C, preferably from 350 to 600°C, particularly preferably from 400 to 500°C. The pressure range is
20 similar to that for drying. In general, calcination is carried out in an oxygen-containing atmosphere in which the oxygen content is from 0.1 to 90% by volume, preferably from 0.2 to 22% by volume, particularly preferably from 0.2 to 10% by volume.

25

The titanium silicate of the present invention having the RUT structure is preferably used as powder when employed as catalyst.

30 The titanium silicate having the RUT structure which has been discussed comprehensively above is particularly suitable for the epoxidation of alkenes. Accordingly, the present invention also provides a process in which an alkene is reacted to form an alkene
35 oxide.

Alkenes which are suitable for such a functionalization are, for example:

ethylene, propylene, but-1-ene, but-2-ene, isobutene,
5 butadiene, pentenes, isoamylene, piperylene, hexenes,
hexadienes, heptenes, octenes, diisobutene,
trimethylpentene, nonenes, dodecene, tridecene,
tetradecanes to eicosenes, tripropylene and
tetraproylene, polybutadienes, polyisobutenes,
10 isoprenes, terpenes, geraniol, linalol, linalyl
acetate, methylenecyclopropane, cyclopentene,
cyclohexene, norbornene, cycloheptene,
vinylcyclohexane, vinyloxirane, vinylcyclohexene,
styrene, cyclooctene, cyclooctadiene, vinylnorbornene,
15 indene, tetrahydroindene, methylstyrene,
dicyclopentadiene, divinylbenzene, cyclododecene,
cyclododecatriene, stilbene, diphenylbutadiene, vitamin
A, beta-carotene, vinylidene fluoride, allyl halides,
crotyl chloride, methallyl chloride, dichlorobutenes,
20 allyl alcohol, methallyl alcohol, butenols,
butenediols, cyclopentenediols, pentenols, octadienols,
tridecenols, unsaturated steroids, ethoxyethylene,
isoeugenol, anethole, isoallesirol, unsaturated
carboxylic acids such as acrylic acid, methacrylic
25 acid, crotonic acid, maleic acid, vinylacetic acid,
unsaturated fatty acids such as oleic acid, linoleic
acid, palmitic acid, and also naturally occurring fats
and oils.

30 An advantage of the titanium silicate having the RUT
structure prepared according to the present invention
is that the crystalline product as described above
resulting from the process of the present invention has
a large specific external surface area. This is
35 generally in the range from 10 to 200 m²/g, preferably
in the range from 80 to 120 m²/g.

These values for the specific external surface area are based on results obtained by nitrogen adsorption in accordance with DIN 66131.

5 Furthermore, the titanium silicate of the present invention having the RUT structure has a particular internal structure in which essentially no pores having a width of $> 5.5 \text{ \AA}$ are present.

10 It is thus possible, without restricting the pore system as in the case of zeolites having a structure other than the RUT structure, for sterically very bulky molecules and/or mixtures of natural materials to be reacted catalytically on the external surface. Since catalysis over the titanium silicate of the present
15 invention having the RUT structure takes place at the external surface, relatively high molecular weight compounds can be reacted in polymer-analogous reactions of all the abovementioned reaction classes.

20 When using the titanium silicate of the present invention having the RUT structure as catalyst in the conversion of an alkene to an alkene oxide, it is possible to employ all oxidants which are suitable for this purpose. Examples which may be mentioned are
25 hydrogen peroxide, compositions which can generate hydrogen peroxide in situ, or organic hydroperoxides.

An advantage of the titanium silicate of the present invention having the RUT structure when used as
30 catalyst is that, in contrast to titanium-containing zeolite catalysts of the prior art, it is possible to use, for example, hydrogen peroxide solutions which have a very low concentration of H_2O_2 .

35 Preference is given to using H_2O_2 solutions whose H_2O_2 concentration is in the range from 0.05 to 40% by

weight, particularly preferably from 0.1 to 20% by weight, in particular from 0.5 to 10% by weight.

Particularly when the oxidant used is a mixture of
5 hydrogen and oxygen, the titanium silicate of the invention having the RUT structure can further comprise one or more elements selected from the group consisting of ruthenium, rhodium, palladium, osmium, iridium, platinum, iron, cobalt, nickel, rhenium, silver and
10 gold in addition to titanium, silicon and oxygen.

Naturally, it is also possible in the process of the present invention for the titanium silicate having the RUT structure used as catalyst to be regenerated after
15 it has become exhausted.

If the catalyst has been used in powder form, it can be regenerated by, for example, washing it with oxidizing mineral acids such as nitric acid and then refluxing it
20 with hydrogen peroxide.

If the titanium silicate of the present invention having the RUT structure has been used as catalyst in the form of a shaped body, the shaped body can be
25 regenerated in or outside the reaction arrangement employed, e.g. a reactor, by treating it with gases which comprise or provide oxygen, e.g. air, synthetic air, nitrogen oxides or molecular oxygen. Here, the catalyst is preferably heated from room temperature to
30 a temperature in the range from 120 to 850°C, preferably from 180 to 700°C and particularly preferably from 250 to 550°C, and air or oxygen is added to an inert gas flowing over the catalyst in concentrations of generally from 0.1 to 90% by volume,
35 preferably from 0.2 to 22% by volume and particularly preferably from 0.2 to 10% by volume, based on the total gas stream. A pressure of generally from 0.01 to

5 bar, preferably from 0.05 to 1.5 bar, is generally employed.

The following examples illustrate the process of the
s present invention without restricting it in any way.

EXAMPLES

Example 1

5 455 g of tetraethyl orthosilicate were placed in a four-necked flask (2 l capacity) and, while stirring (250 rpm, blade stirrer), 15 g of tetraisopropyl orthotitanate were added from a dropping funnel over a period of 30 minutes. A colorless, clear mixture was
10 formed. Finally, 800 g of a 20% strength by weight tetramethylammonium hydroxide solution (alkali metal contents < 10 ppm) was added and the mixture was stirred for another one hour. The alcohol mixture (about 450 g) formed by hydrolysis was distilled off at
15 90 - 100°C. 1.5 l of deionized water were added and the now slightly opaque sol was transferred to a 2.5 l stirring autoclave (stainless steel 1.4571).

At a heating rate of 3°C/min, the closed autoclave
20 (anchor stirrer, 200 rpm) was brought to a reaction temperature of 175°C. The reaction was ended after 10 days. The cooled reaction mixture was centrifuged and the solid was washed a number of times with water until neutral. The solid obtained was dried at 100°C for 24
25 hours (weight: 149 g).

Finally, the template remaining in the product was burnt off in air at 550°C for 5 hours (calcination loss: 14% by weight).

30

The calcined product had a Ti content of 1.5% by weight and a residual alkali metal content of less than 100 ppm according to wet chemical analysis. The yield based on SiO₂ used was 87%. The crystallites had a size
35 of from 0.05 to 0.25 µm and the product displayed a typical band at about 960 cm⁻¹ in the IR.

The product displays the X-ray diffraction pattern reproduced in Figure 1. In Figure 1, the intensity I is plotted on the ordinate.

5

Example 2

A 250 ml glass autoclave was charged with 36 g of methanol and 0.5 g of titanium silicate powder from
10 Example 1 and the suspension was stirred by means of a magnetic stirrer. The closed glass autoclave was then cooled to -30°C and 10 g of propene were injected. Subsequently, the glass autoclave was warmed to 0°C and 17 g of a 30% strength hydrogen peroxide solution were
15 metered in. The reaction mixture was stirred at 0°C for 5 hours under the autogenous pressure. The catalysts was then centrifuged off and the propylene oxide content was determined by gas chromatography. The propylene oxide content was 0.3% by weight.

20

Example 3

A 250 ml glass autoclave was charged with 36 g of methanol and 0.5 g of titanium silicate from Example 1
25 and the suspension was stirred by means of a magnetic stirrer. The closed glass autoclave was then cooled to -30°C and 20.2 g of propene were injected. Subsequently, the glass autoclave was warmed to 0°C and 23 g of 0.5% strength hydrogen peroxide solution were
30 metered in. The reaction mixture was stirred at 0°C for 30 minutes under the autogenous pressure. The catalyst was then centrifuged off and the propylene oxide content was determined by gas chromatography. The propylene oxide content was 0.098% by weight.

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We claim:

1. A process for preparing a titanium silicate having the RUT structure, which comprises the steps (i) and (ii):
 - (i) preparation of a mixture comprising at least one SiO_2 source and at least one titanium source;
 - (ii) crystallization of the mixture from (i) in a pressure vessel with addition of at least one template compound to give a crystallization product,wherein the template compounds used are amines or ammonium salts which are suitable for stabilizing cages of the silicate structure $[4^45^46^2]$ and $[4^45^66^58^1]$.
2. A process as claimed in claim 1 which additionally comprises the steps (iii) and (iv):
 - (iii) drying of the crystallization product resulting from (ii);
 - (iv) calcination of the dried product from (iii).
3. A titanium silicate having the RUT structure, able to be prepared by a process comprising the steps (i) and (ii):
 - (i) preparation of a mixture comprising at least one SiO_2 source and at least one titanium source;
 - (ii) crystallization of the mixture from (i) in a pressure vessel with addition of at least one template



compound to give a crystallization product,

wherein the template compounds used are amines or ammonium salts which are suitable for stabilizing cages of the silicate structure $[4^45^46^2]$ and $[4^45^66^58^1]$.

4. A titanium silicate having the RUT structure as claimed in claim 3 whose titanium content is in the range from 0.001 to 5% by weight.

5. A titanium silicate having the RUT structure as claimed in claim 3 or 4 which has at least the following reflections in the X-ray diffraction pattern:

Diffraction angle 2θ	Lattice plane spacing d (0.1 nm)
10.79	8.19
13.69	6.45
14.48	6.10
20.19	4.49
22.16	4.00
23.26	3.82
27.45	3.24

6. A titanium silicate having the RUT structure as claimed in any of claims 3 to 5 which has a band in the range from 955 to 970 cm^{-1} in the IR spectrum.

7. The use of a titanium silicate having the RUT structure prepared as claimed in claim 1 or 2 or a



titanium silicate having the RUT structure as claimed in any of claims 3 to 6 as catalyst.

- 5 8. A process for the reaction of an organic compound, which comprises bringing the organic compound into contact with a titanium silicate as claimed in any of claims 3 to 6 during the reaction.
- 10 9. A process as claimed in claim 8, wherein the organic compound is oxidized during the reaction.
10. A process as claimed in claim 8 or 9, wherein an alkene is reacted to form an alkene oxide.

