Reaction of oleum with the corresponding alkane after or during addition of the initiator/ initiator-solution in a high-pressure-reactor.
Quenching of non-reacted starting material
Purification (e.g. distillation, crystallization etc.)
Recycling of the inert solvent (e.g. sulfuric acid).
According to said prior art, the initiator is particularly prepared by reacting an alkane sulfonic acid R–SO_3H, i.e. the desired product, with hydrogen peroxide to form an initiator-precursor R–SO_2–O–OH. Said initiator-precursor is then reacted with SO_3 yielding initiator compounds such as R–SO_2–O–O-SO_3H. The cited prior art therefore requires some amount of the desired product to form an initiator.

It is thus the object of the present disclosure to provide novel catalysts for the homogeneous catalysis in the preparation of alkane sulfonic acids, especially methane sulfonic acid (MSA). Particularly, it is the object of the invention to provide catalysts that do not require the desired product itself to be present as an initiator-precursor. Further, requirements for sulfurtrioxide and alkanes should be of no relevance, meaning that not only absolute pure raw materials might be used, but that impurities do not affect negatively the reaction.

In an aspect, there is provided the use of a cation being stable under super acid conditions as catalyst in the preparation of alkanes sulfonic acids from alkanes and sulfur trioxide, especially in the preparation of methane sulfonic acid from methane and sulfur trioxide, said cation being able to react with the alkane to form an alkyl cation, wherein stability means that the cation is able to react with the alkane but does not decompose within 24 h at room temperature (20 °C), and wherein the cation is selected from a halogen cation, especially I^+ and Br^+, S^+, Se^+, Te^+, As^+, Sb^+, P^+ and/or Si^+.

In another aspect, there is provided a process for the preparation of alkane sulfonic acids, especially of methane sulfonic acid, comprising the steps of

i) providing sulfur trioxide and an alkane, especially methane, to a reaction chamber,
ii) setting a pressure of from 1 to 200 bar to the reactor,
iii) introducing a compound forming *in situ* a cation into said reactor, wherein the cation is selected from a halogen cation, especially I^+ and Br^+, S^+, Se^+, Te^+, As^+, Sb^+, P^+ and/or Si^+,
iv) controlling the temperature in the reactor to be at 0 °C to 100 °C,
v) after the reaction is finished, if necessary, purifying the reaction product.

In another aspect, there is provided a process for the preparation of alkane sulfonic acids, especially of methane sulfonic acid, comprising the steps of

i) providing sulfur trioxide and an alkane, especially methane, to a reaction chamber,
ii) setting a pressure of from 1 to 200 bar to the reactor,
iii) introducing a cation being stable under super acid conditions into said reactor, wherein stability means that the cation is able to react with the alkane but does not decompose within 24 h at room temperature (20 °C), and wherein the cation is selected from a halogen cation, especially I^+ and Br^+, S^+, Se^+, Te^+, As^+, Sb^+, P^+ and/or Si^+,

iv) controlling the temperature in the reactor to be at 0 °C to 100 °C,

v) after the reaction is finished, if necessary, purifying the reaction product.

In another aspect, there is provided a mixture comprising an alkane, sulfur trioxide, a cation being able to react with the alkane to form an alkane cation, wherein the cation is selected from a halogen cation, especially I^+ and Br^+, S^+, Se^+, Te^+, As^+, Sb^+, P^+ and/or Si^+, and optionally a solvent.

In another aspect, there is provided a mixture comprising an alkane, sulfur trioxide, a compound forming *in situ* a cation under super acid conditions, said cation being able to react with the alkane to form an alkane cation, wherein the cation is selected from a halogen cation, especially I^+ and Br^+, S^+, Se^+, Te^+, As^+, Sb^+, P^+ and/or Si^+, and optionally a solvent.

In a first embodiment, the object of the present invention is solved by the use of a cation being stable under acid or super acid conditions as catalyst in the preparation of alkane sulfonic acids from alkanes and sulfur trioxide, especially in the preparation of methane sulfonic acid from methane and sulfur trioxide, said cation being able to react with the alkane to form an alkyl cation. The alkyl cation will afterwards react with sulfur trioxide forming the alkane sulfonic acid. Particularly, methane, ethane, propane, butane, isopropane, isobutane or a higher alkane can be reacted with sulfur trioxide to form the corresponding alkane sulfonic acid. Higher alkane within the meaning of the present application are straight or branched alkanes with 20 C-atoms or less.

Surprisingly it has been found that cations which are stable under acid or super acid conditions are able to react under said conditions with the alkane ALK and form an alkane cation:

$$Y^+ + ALK \quad ---> \quad HY + ALK^+ \qquad (R1)$$

The cation Y^+ may be either a stable cation and added as cation to the reaction solution. Alternatively, the cation can form *in situ* during the reaction according to the following reaction scheme:

$$H^+ + A \quad ----> \quad HX + Y^+ \qquad (R2)$$

The cation is used in the production of alkane sulfonic acid from an alkane and sulfur trioxide. The reaction conditions are strongly acid or even super acid in his reaction. A super acid is an acid with an acidity greater than that of 100% pure sulfuric acid. Strongly acid means an acidity of 100% pure sulfuric acid or at least similar to it.