In the commercial use of catalysts, a further improvement in the economics, in particular an increase of the conversion to the target product, and/or a reduction in the formation of undesirable by-products are of greatest interest.

In view of this background, it was the object of the present invention to provide an improved process for producing shaped metal oxide catalyst bodies, which results, in particular, in shaped catalyst bodies which have a higher activity and/or selectivity compared to catalysts of the prior art.

This object is achieved by the process of the invention and the catalysts which can be obtained thereby.

The increased activity of the catalysts of the invention compared to conventional catalysts makes it possible to carry out the corresponding catalytic processes at lower pressures or temperatures. This fact leads to a considerable cost saving for the plant operator. A temperature decrease in particular leads to a longer operating life of the catalyst since it slows deactivation due to sintering effects, carbonization or the by-products coating the surface. In addition, more active catalysts make it possible to carry out the corresponding reactions at higher space velocities. An equal throughput can therefore be achieved using smaller reactors, which means a considerable reduction in capital costs for a plant operator. A decrease in temperature can additionally lead to a reduction in the amount of by-products. Furthermore, improved selectivity reduces the outlay in terms of apparatus for the removal of by-products and thus the work-up costs for the product.

Summary of the invention

The ~~invention~~ disclosure provides a process for producing a shaped

catalyst body, which comprises the following steps:

(a) Mixing of one or more metal oxides, preferably in the form of a powder, with graphite, and

(b) Shaping of this mixture to give a shaped body, where the particle diameter D_{90} of the graphite is:

$$2.0\ \mu m \leq D_{90} \leq 17.5\ \mu m.$$

The ~~invention~~ disclosure further provides shaped catalyst bodies which can be produced by the process of the invention.

The ~~invention~~ disclosure additionally provides for the use of the shaped catalyst bodies of the invention in catalytic reactions, in particular in hydrogenation and dehydrogenation reactions, hydrogenolysis reactions, CO hydrogenation and water gas shift reactions.

In one aspect, there is provided a process for producing a shaped catalyst body, which comprises the following steps: (a) Mixing of a metal oxide, preferably in the form of a powder, with graphite, and (b) Shaping of this mixture to give a shaped body, where the particle diameter D90 of the graphite is:

$$5.0\ \mu m \leq D_{90} \leq 17.5\ \mu m.$$

Another aspect provides a shaped catalyst body obtainable by a process as defined herein., wherein the shaped catalyst body comprises graphite having a particle diameter D90 of $5.0\ \mu m \leq D_{90} \leq 17.5\ \mu m$.

Yet another aspect relates to the use of the shaped catalyst body as defined herein as catalyst for a reaction in which hydrogen occurs as starting material, intermediate or product.

Detailed description of the invention

The invention describes a shaped catalyst body which consists of a mixture of at least one metal oxide with at least one graphite having specific properties. In addition, the invention comprises a corresponding process for producing the shaped body.

For the purposes of the present invention, metal oxides are generally compounds of a metal with oxygen. The metal can be present in oxidic form in various stoichiometric compositions with the oxygen. The metal can be present in one or more different oxidation states in the metal oxide. The expression metal oxide in its general meaning also includes oxides of one or more metals in the form of a particular or a plurality of different modifications or crystal structures. In its widest meaning, the term metal oxide also includes compounds which can be converted into the metal oxides (e.g. by thermal treatment). These include, in

CLAIMS

1. A process for producing a shaped catalyst body, which comprises the following steps:

(a) Mixing of a metal oxide, preferably in the form of a powder, with graphite, and

(b) Shaping of this mixture to give a shaped body, where the particle diameter D_{90} of the graphite is:

~~2.0~~5.0 µm ≤ D_{90} ≤ 17.5 µm.

2. The process as claimed in claim 1, wherein the specific surface area O_G of the graphite is:

10 m^2/g ≤ O_G ≤ 1000 m^2/g, preferably
300 m^2/g ≤ O_G ≤ 600 m^2/g.

3. The process as claimed in claim 1 or 2, wherein the particle diameter D_{90} of the graphite is:

~~4.0 µm ≤ D_{90} ≤ 17.5 µm,~~
preferably 5.0 µm ≤ D_{90} ≤ 15.0 µm,
in particular 6.0 µm ≤ D_{90} ≤ 10.0 µm.

4. The process as claimed in claim 1, 2 or 3, wherein the particle diameter D_{50} of the graphite is:

2.0 µm ≤ D_{50} ≤ 9.0 µm, preferably 2.5 µm ≤ D_{50} ≤ 8.0 µm.

5. The process as claimed in claim 1, 2, 3 or 4, wherein the particle diameter D_{10} of the graphite is:

$$1.0\ \mu m \leq D_{10} \leq 4.0\ \mu m, \text{ preferably } 1.1\ \mu m \leq D_{10} \leq 3.2\ \mu m.$$

6. The process as claimed in claim 1, 2, 3, 4 or 5,

wherein the graphite has the following particle diameters:

~~4.0~~5.0 µm ≤ D_{90} ≤ 17.5 µm
2.0 µm ≤ D_{50} ≤ 9.0 µm and
1.0 µm ≤ D_{10} ≤ 4.0 µm,

preferably:
6.0 µm ≤ D_{90} ≤ 10.0 µm,
2.5 µm ≤ D_{50} ≤ 8.0 µm and
1.1 µm ≤ D_{10} ≤ 3,2 µm.

7. The process as claimed in any of the preceding claims, wherein the mixture of step (a) contains graphite in an amount of from 0.1 to 20.0% by weight, preferably in the range from 1.0 to 14.0% by weight, in particular in the range from 2.0 to 12.0% by weight, particularly preferably in the range from 4.0 to 10.0% by weight, based on the total weight of the metal oxide/graphite mixture.

8. The process as claimed in any of the preceding claims, wherein graphite comprises a mixture of various graphites.

9. The process as claimed in any of the preceding claims, wherein the metal oxide is selected from among copper oxide, zinc oxide, aluminum oxide, silicon oxide, titanium oxide, manganese oxide, nickel oxide, chromium oxide, iron oxide, cobalt oxide, molybdenum oxide, calcium oxide, barium oxide, zirconium oxide and mixtures thereof, preferably copper oxide, zinc oxide, aluminum oxide, manganese oxide, chromium oxide, nickel oxide and mixtures thereof, in particular copper oxide, aluminum oxide, zinc oxide, manganese oxide and mixtures thereof, and is particularly preferably copper oxide; the metal of the metal oxide can be present independently in one oxidation state and/or in a plurality of different oxidation states.

remains in the shaped catalyst bodies.

12. The process as claimed in claim 11, wherein the temperature in step (d) is in the range from 150°C to 550°C, preferably in the range from 250°C to 350°C.

13. The process as claimed in any of the preceding claims, wherein the shaping in step (b) is carried out by a process selected from among tabletting, extrusion, granulation and pelletization.

14. The process as claimed in any of the preceding claims, wherein the graphite has a thermal conductivity of from 120 to 250 W/m*K, preferably from 130 to 200 W/m*K, particularly preferably from 140 to 170 W/m*K.

15. The process as claimed in any of the preceding claims, wherein the graphite has an electrical conductivity parallel to the layer structure of from $1.5*10^6$ to $8*10^6$ S/m, preferably from $2*10^6$ to $6*10^6$ S/m, particularly preferably from $2.5*10^6$ to $5*10^6$ S/m.

16. A shaped catalyst body obtainable by a process as claimed in any of the preceding claims~~.~~, wherein the shaped catalyst body comprises graphite having a particle diameter D_{90} of 5.0 µm ≤ D_{90} ≤ 17.5 µm.

17. The use of the shaped catalyst body as claimed in claim 16 as catalyst for a reaction in which hydrogen occurs as starting material, intermediate or product.

18. The use as claimed in claim 17, wherein the reaction is selected from the group consisting of hydrogenation and dehydrogenation reactions, hydrogenolysis reactions, CO hydrogenation and water gas shift reactions.

19. The use as claimed in claim 18, wherein the reaction is a hydrogenation of carbonyl compounds, in