~~Description~~

Nano-wires made of novel precursors and method for the production thereof

The present invention ~~relates to nanowires which consist of or comprise semiconductor materials and which serve for applications in photovoltaics and electronics, and also to a method for production thereof. A feature of the nanowires is that they are obtained by an innovative method using innovative precursors. The precursors constitute compounds or mixtures of compounds each having at least one direct Si-Si and/or Ge-Si and/or Ge-Ge bond, with substituents which consist of halogen and/or hydrogen and with a composition in which the atomic ratio of substituents to metalloid atoms is at least 1:1~~ proposes a method of producing nanowires as defined by claim 1.

Prior art:

Described in the prior art, for the production of silicon nanowires, is the thermal decomposition of gaseous silicon precursor compounds. Here, besides various silicon compounds, catalytically active metals are employed. Generally speaking, catalyst metal agglomerates of a few nanometers in diameter are produced first of all, and then act catalytically on the decomposition of the silicon compounds and contribute to the ordered deposition of the elemental silicon formed. Depending on the reaction conditions, the resulting nanowires are crystalline or wholly or partly amorphous. It is preferred to use metals which exhibit eutectic mixtures with a low melting temperature with silicon. The model conception says that, under the reaction conditions, a liquid metal/Si mixture is formed, from which, finally, solid Si deposits as a result of further uptake of Si from the

Claims

1. A method for producing nanowires which consist of or comprise semiconductor materials and serve for applications in photovoltaics and electronics by reacting precursors, characterized in that the precursors constitute compounds or mixtures of compounds each having at least one direct Si-Si and/or Ge-Si and/or Ge-Ge bond, with substituents consisting of halogen or halogen and hydrogen and with a composition in which the atomic ratio of substituents to metalloid atoms is at least 1:1, further characterized in that the precursors are decomposed over catalysts for the deposition of the nanowires of the invention, with catalysts employed being metals, preferably transition metals, or mixtures thereof.

2. Method according to claim 1, characterized in that the precursors and hydrogen are reacted, wherein a precursor:hydrogen mixing ratio of 1:0 to 1:1 000 000 is operated.

3. The method according to claim 1, characterized in that the deposition takes place without presence of hydrogen in elemental or bonded form.

4. The method according to any of the preceding claims, characterized in that less than 10 mass-% of pulverulent by-products occur in the deposition of the nanowires.

5. The method according to any of the preceding claims, characterized in that a pressure range of 0.1 - 2200 hPa, preferably 1 to 1200 hPa is operated.

6. The method according to any of the preceding claims, characterized in that the deposition takes place at a temperature of 250°C to 1100°C, preferably 300°C to 950°C, more preferably, in particular 350°C to 900°C.

7. The method according to any of the preceding claims, characterized in that different precursors for the growth are used in temporal alternation, the precursors being switched at least once during the process.

8. The method according to any of the preceding claims, characterized in that nanowires having compositions which alternate in growth direction are obtained.

~~9. The method according to either any of the preceding claims characterized in that the precursors are decomposed over catalysts for the deposition of the nanowires of the invention, with catalysts employed being metals, preferably transition metals, or mixtures thereof.~~

~~10~~9. The method according to either of the preceding claims, characterized in that the precursors contain virtually no rings, the amount of rings, based on the overall product mixture, being below < 2% by mass and/or the precursors contain virtually no branched chains, the amount of branching sites, based on the overall product mixture, being below < 5% by mass, preferably < 2% by mass.

~~11~~10. The method according to either of claims 1 to ~~9~~8, characterized in that the precursors consist

predominantly of branched chains.

~~12~~11. The method according to any of the preceding claims, characterized in that the precursors possess an average chain length n of n = 2-6, preferably n = 2-5.

~~13~~12. The method according to any of the preceding claims, characterized in that the precursors are readily soluble in inert solvents.

~~14~~13. The method according to any of the preceding claims, characterized in that the precursors are not pyrophoric, such as, for example, highly halogenated polysilanes, the halogen being more particularly Cl and/or Br.

~~15~~14. The method according to any of the preceding claims, characterized in that the precursors have an H content of less than 5 atom%, preferably less than 2 atom%.

~~16~~15. The method according to any of the preceding claims, characterized in that the precursors comprise p-doping atoms and/or n-doping atoms incorporated in the precursor molecules and/or as separate additives in the mixture.

~~17~~16. The method according to any of the preceding claims, characterized in that the precursors are suitable both for the gas/liquid/solid phase growth process and for the gas/solid/solid phase growth process.

~~18~~17. The method according to any of the preceding claims, characterized in that admixtures from the

group of the monosilanes and/or the monogermanes having been added additionally to the precursors.