the failure for the carbon to be uniformly mixed into the silicon melt thereby localizing the regions with high carbon concentration, possibly causing the single crystals to have dislocation.

Citation List

Patent Literatures

[0009]

[Patent Literature 1] JP-B-5104437

[Patent Literature 2] JP-A-2012-171822

[Patent Literature 3] JP-A-H11-312683

Summary

[0009a]

In one aspect of the present disclosure, there is provided a process for producing a silicon single crystal by heating a silicon raw material held in a crucible to provide a silicon melt and allowing a silicon single crystal to grow during the pulling-up of a silicon single crystal ingot from the silicon melt, the process comprising using, as at least part of the silicon raw material, crushed materials of a polycrystalline silicon rod produced by Siemens process, the crushed materials obtained by crushing an end of the rod in the vicinity contacting a carbon core wire holding member, wherein a carbon concentration of the crushed materials is from 0.04 to 2.8 ppma, and the crushed

materials are obtained by removing a core including both the carbon core wire holding member embedded into the rod end and a polycrystalline silicon surrounding the carbon core wire holding member from the rod end cut off from the polycrystalline silicon rod to give a rod end hollow body, and thereafter crushing the rod end hollow body.

Technical Problem

[0010]

As in the foregoing, in the process for producing a silicon single crystal in which carbon is incorporated into a silicon single crystal to be pulled up in order to inhibit the dislocation and the reduction in strength, the significant problem to be solved had been to develop a process which easily allows carbon to be mixed and dissolved into a silicon melt and allows the carbon to be incorporated with low cost and which provides excellence in operability in introducing a polycrystalline silicon raw material into a crucible. In particular, the development of the process allowing a necessary concentration of carbon to be mixed and

CLAIM

1. A process for producing a silicon single crystal by heating a silicon raw material held in a crucible to provide a silicon melt and allowing a silicon single crystal to grow during the pulling-up of a silicon single crystal ingot from the silicon melt, the process comprising using, as at least part of the silicon raw material, crushed materials of a polycrystalline silicon rod produced by Siemens process, the crushed materials obtained by crushing an end of the rod in the vicinity contacting a carbon core wire holding member, wherein a carbon concentration of the crushed materials is from 0.04 to 2.8 ppma, and the crushed materials are obtained by removing a core including both the carbon core wire holding member embedded into the rod end and a polycrystalline silicon surrounding the carbon core wire holding member from the rod end cut off from the polycrystalline silicon rod to give a rod end hollow body, and thereafter crushing the rod end hollow body.

2. The process for producing a silicon single crystal according to claim 1, wherein a substantial whole region

of a straight body part of the silicon single crystal ingot has a carbon concentration of 0.01 to 1 ppma.

3. The process for producing a silicon single crystal according to claim 1 or 2, wherein the crushed materials have a particle size such that at least 90% by mass of the crushed

materials falls within the range from 2 to 50 mm for a length of a long diameter.

4. The process for producing a silicon single crystal according to claim 1, comprising:

measuring a carbon concentration distribution at the rod end of the polycrystalline silicon rod produced by Siemens process in the vicinity contacting with the carbon core wire holding member,

varying a diameter of a core to be removed, based on the measured carbon concentration distribution, in the production by the process according to claim 1 of crushed materials in the vicinity of the core wire holding member from another polycrystalline silicon rod produced in the same silicon deposition furnace and under the same deposition conditions as

the polycrystalline silicon rod, and

using the crushed materials thus obtained with a carbon concentration adjutsed as at least part of the silicon raw material.

5. The process for producing a silicon single crystal according to claim 4, wherein the silicon single crystal is produced by multi-pulling, and the crushed materials in the vicinity of the core wire holding member with a carbon concentration adjusted are used as a recharging silicon raw material in the multi-pulling.

6. The process for producing a silicon single crystal according to any one of claims 1 to 5, which provides a silicon single crystal for producing a substrate of a solar cell.