Title of Invention

Glue and coating for refractory materials and ceramics.

Field of Invention

The present invention relates to a glue and a coating for refractory materials and ceramics, such as carbon materials, silicon nitride, silicon carbide and quartz.

Technical background

It is known a plurality of glues for gluing refractory materials and ceramics such as carbon materials, silicon nitride, silicon carbide and quartz which are to be used at high temperatures. From US patent No. 5,474,849 ~~is~~ it is thus known a glue for carbon components. The glue comprises a thermoset ~~polysilagen~~ polysilazane polymer, 20 to 50 % by weight based on the weight of polymer of a ceramic powder which can be SiC, 10-40 % by weight based on the weight of polymer of Si-powder and 5-15 % by weight based on the weight of polymer of carbon powder.

It has however been found that this type of glue is not suitable for carbon material, silicon nitride, silicon carbide and quartz that is to be used in furnaces, moulds, crucibles or details for such intended to be contact with molten silicon. It is important that glue used in connection with parts does not contaminate the molten silicon which is in contact with the mentioned furnaces, moulds, crucibles or details for such. This is particularly important in connection with treatment of high purity silicon which is to be used for the production of solar cells. It is further important that the glue joints are not wettable by molten silica.

Description of the Invention

By the present invention it is provided a glue and coating which is easy to use, has a good strength at high temperatures, is not wettable by molten silicon and that can be stored for a long time. The glue and coating further has the surprising effect that it ~~looses~~ loses its strength during cooling from high

temperatures and down to below 1000°C. This effect is particularly useful when the glue is used for gluing together moulds made from separate sheets of for instance silicon nitride, quartz or graphite used for directional solidification of molten silicon. During cooling of silicon a solid phase transformation takes place which results in a volume increase and may cause failure of the moulds. By the use of moulds made from separate sheets glued with the glue according to the present invention the glue will at the temperature where the phase transformation takes place have a low strength and the moulds will therefore crack in the glue layers while the individual sheets ~~not~~ will not be damaged. The sheets can therefore be reused for making new moulds.

The present invention thus relates to a heat curable glue or coating for use in connection with carbon materials, silicon nitride, silicon carbide and quartz, which glue or coating consist of 25 to 50 % by weight of silicon powder, 5 to 20 % by weight of silicon carbide powder, 20 to 60 % by weight of ~~fenol~~ phenol formaldehyde resin or polyfurfuryl alcohol and 10 to 30 % by weight of an organic solvent wherein the heat curable glue or coating is free from any carbon powder.

According to a preferred embodiment the organic solvent is selected ~~among~~ from monoethylene glycol, diethylene glycol and triethylene glycol. The preferred organic solvent is monoethylene glycol.

The solvent is added in an amount sufficient to obtain a suitable viscosity of the glue or coating.

According to a preferred embodiment the glue or coating comprises 35 to 45 % by weight of silicon powder, 8 to 18 % by weight of silicon carbide powder, 25 to 35 % by weight of formaldehyde resin or polyfurfuryl alcohol and 15 to 25 % by weight of organic solvent.

According to another preferred embodiment the glue or coating contains a curing agent in order to lower the polymerization temperature for the formaldehyde resin or the polyfurfuryl alcohol. The curing agent is preferably

Claims

1. A ~~H~~heat curable glue or coating for use in connection with refractory materials and ceramics, characterized in that the glue or coating comprises 25 to 50 % by weight of silicon powder, 5 to 20 % by weight of silicon carbide powder, 20 to 60 % by weight of ~~fenol~~ phenol formaldehyde resin or polyfurfuryl alcohol and 10 to 30 % by weight of an organic solvent, said heat curable glue or coating being free from carbon powder.

2. The g~~G~~lue or coating ~~according to~~ of claim 1, characterized in that the organic solvent is selected ~~among~~ from the group consisting of monoethylene glycol, diethylene glycol and triethylene glycol.

3. The g~~G~~lue or coating ~~according to~~ of claim 1, characterized in that the glue or coating comprises 35 to 45 % by weight of silicon powder, about 8 to 18 % by weight of silicon carbide powder, 25 to 35 % by weight of formaldehyde resin or ~~polyfufuryl~~ polyfurfuryl alcohol and 15 to 25 % by weight of organic solvent.

4. The g~~G~~lue or coating ~~according to~~ of claim ~~1-3~~ 1, 2 or 3, characterized in that the glue or coating contains a curing agent which ~~in order to~~ lowers the polymerization temperature ~~for~~ of the phenol formaldehyde resin or the polyfurfuryl alcohol.

5. The g~~G~~lue or coating ~~according to~~ of claim 4, characterized in that the curing agent is selected ~~among~~ from the group consisting of hexamine, aluminium phosphate ~~or~~ and an acid.

6. The g~~G~~lue or coating ~~according to~~ of claim 5, characterized in that the acid is selected ~~among~~ from the group consisting of sulfuric acid, para-~~toulene~~ toluene ~~sulphonic~~ sulfonic acid neutralized with urea and para-~~toulene~~ toluene ~~sulphonic~~ sulfonic acid ~~etyl~~ ethyl ester.

7. A heat curable glue or coating for use in connection with refractory materials and ceramics consisting of 25 to 50 % by weight of silicon powder, 5 to 20 % by weight of silicon carbide powder, 20 to 60 % by weight of phenol formaldehyde resin or polyfurfuryl alcohol and 10 to 30 % by weight of an organic solvent.