TO:             KSI/Scientific & Technical Information Division
Attention:     Miss Winnie M. Morgan

FROM:         GP/Office of Assistant General Counsel for
Patent Matters

SUBJECT:     Announcement of NASA-Owned U.S. Patents in STAR

In accordance with the procedures agreed upon by Code GP and Code KSI, the attached NASA-owned U.S. Patent is being forwarded for abstracting and announcement in NASA STAR.

The following information is provided:

U.S. Patent No. 3,745,082

Government or Corporate Employee: U.S. Government

Supplementary Corporate Source (if applicable): MS

NASA Patent Case No. ERC-10339-1

NOTE - If this patent covers an invention made by a corporate employee of a NASA Contractor, the following is applicable:

Yes [X] No [ ]

Pursuant to Section 305(a) of the National Aeronautics and Space Act, the name of the Administrator of NASA appears on the first page of the patent; however, the name of the actual inventor (author) appears at the heading of column No. 1 of the Specification, following the words "with respect to an invention of . . . ."

Elizabeth A. Carter
Enclosure
Copy of Patent cited above
SEMICONDUCTOR SURFACE PROTECTION MATERIAL

Richard D. Packard, Brighton, Mass., assignor to the United States of America as represented by the National Aeronautics and Space Administration

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Int. Cl. H01b 1/04

U.S. Cl. 156—285 2 Claims

ABSTRACT OF THE DISCLOSURE

A method and a product for protecting semiconductor surfaces is disclosed. The protective coating material is prepared by heating a suitable protective resin with an organic solvent which is solid at room temperature and converting the resulting solution into sheets by a conventional casting operation. Pieces of such sheets of suitable shape and thickness are placed on the semiconductor areas to be coated and heat and vacuum are then applied to melt the sheet and to drive off the solvent and cure the resin. A uniform adherent coating, free of bubbles and other defects, is thus obtained exactly where it is desired.

ORIGIN OF THE INVENTION

The invention described herein was made by an employee of the United States Government and may be manufactured and used by or for the Government for governmental purposes without payment of any royalties thereon or therefor.

BACKGROUND OF THE INVENTION

The invention relates to the application of protective coatings to the exposed p-n junctions of semiconductors, and more specifically to the use of semiconductor coating materials that do not contain low boiling solvents.

After the p-n junction surfaces of a semiconductor have been etched, rinsed and dried, a protective coating, frequently a silicone resin, is applied. The prior art coating materials are varnish-like compositions, usually silicone resins dissolved in toluene, xyline, or the like. The varnishes are quite viscous and are therefore difficult to meter for application and to apply in spatially restricted areas without smearing. Frequently, such coatings do not flow well enough to cover the surface to be protected in a uniform manner without the use of temperatures that may damage devices such as those encapsulated in molded plastic. If the quantity of such coating material deposited in a restricted area is great enough, volatile material may evolve during the "second sealing" (sealing in the other electrical lead and contact) despite the use of vacuum and elevated temperatures in the curing operation.

SUMMARY OF THE INVENTION

This invention relates to a method and a product for protecting semiconductor surfaces without the use of the prior art varnishes which contain low boiling solvents. In accordance with this invention, a suitable protective resin is added to an organic solvent which is solid at room temperature, the mixture is melted and mixed thoroughly, and it is then cast to form sheets. A piece of such a sheet of suitable shape and thickness is placed on the surface to be protected, and heat and vacuum are applied to melt the solid solvent-resin mixture to spread it over the surface, to drive off the solvent and to cure the resin.

This method of applying protective resins to surfaces eliminates the use of the viscous varnish-type resins which are difficult to apply accurately in spatially restricted areas. It does not require possibly harmful high temperatures to spread the resin over the surface and there is no residual volatile material to be released during the second sealing operation.

It is therefore an object of this invention to provide a sheet of resin and a solid organic solvent, melting the mixture and heating under a vacuum to expel the solvent and cure the resin in place.

It is another object of this invention to provide a sheet of a solid organic solvent resin mixture for use in protecting semiconductor surfaces.

It is a further object of this invention to provide semiconductor protective coating material in a form which makes possible precise and neat application to the surface to be protected.

BRIEF DESCRIPTION OF THE DRAWINGS

The above objects and others will become apparent from the following detailed description of the invention when read in conjunction with the annexed drawings in which:

FIG. 1 shows a semiconductor in a glass housing and illustrates the manner in which a piece of solid solvent resin sheet is introduced in position in the housing.

FIG. 2 shows the piece of solid solvent resin sheet in position on the junction of the semiconductor.

FIG. 3 shows the semiconductor with the protective resin in position about the junction.

DESCRIPTION OF THE INVENTION

FIG. 1 shows a typical semiconductor consisting of a glass cylinder 1 with a base 2 of a metal alloy having the same coefficient of thermal expansion as the glass hermetically sealed to the cylinder. A diode or rectifier 3 is soldered to the metal base within the glass cylinder and an electrical lead 4 is welded to the base.

A piece of sheet of solid solvent protective resin mixture 5, prepared as hereinafter described and cut so that it just fits within the glass cylinder, is picked up by a vacuum holding device 6 and positioned above the diode or rectifier and the metal base, as shown in FIG. 2.

Heat is then applied to the solid solvent resin sheet to melt it so that the resin will spread over and about the base and the diode or rectifier. Further heating and the application of vacuum remove the solvent and cure resin 7 in situ, as shown in FIG. 3.

The protective resin used in my invention may be a silicone polymer, a silicone rubber, or an epoxy resin, each well known in the art, and available in the form of various commercial products. The silicone resins contain the repeating groups

\[ R \quad O \quad O \quad R \]

where the R groups may be alkyl, aromatic, hydrogen, chlorine, alkoxyl, acyloxy, etc. The silicone rubbers contain the repeating group

\[ R \quad S \quad O \quad R \]

where R may be a monovalent alkyl group containing not over four carbon atoms, or phenyl, tolyl or xylyl groups.

The silicones may be cured or cross-linked by heating with suitable agents, such as ferric chloride, concentrated sulfuric acid, sulfiuryl halide, phenyl phosphoryl dichloride, alkoxyl phosphoryl dibalides or an acyl peroxide.

Among the conventional silicone compounds which may be used are Dow Corning Sylgard 182, 183, 184 and 185.
a curing agent or hardener to form the thermoset resins. Dow Corning Silastic 501, 502, 503, 521 and 588, Dow (O)(OH) resin containing 1 gram equivalent of epoxide) of about 1000 and are prepared by heating an epoxy intermediate with

cure it. Dow Corning Protective Coating 145 and 630, and Emerson (O)« 3,1,2,4-benzenetriamine CiHs(NHj)2,4,6-trichloroaniline C«Hi(NHj)ClBu

pentachlorobenzene C»(Cl)i

1,2,4,5-tetramethyl benzene CiHi(CHs)(CHs)(CHs)N-diehloro-p-toluene sulfuramide CiH

3,4,5-trimethyl benzene C3H6(CHs)3

O-C(CHs)(OH.CO(CiH4)CHjO

Acetoacetanilide CiHuNH-CO-CHjCO-CHj

Naphthalene •- CioHj

Benzene hexachloride C»(Cl)i

p,p'-Dihydroxydiphenyl carbinol CtHrfCiHiOHJjCOH

1,1,1-triphenylethane (CiH

1,1,1-triphenylethanol

Naphthalene

Anthracene

1,7,7-trimethylcyclo(2,2,1)hept-2-ene

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U.S. Cl. X.R.

117—123, 201, 229; 156—306; 161—206, 208, 407; 260—30.4 SB, 33.4 SB, 37 SB, 448.2, 264—92