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METHOD OF POLISHING HYGROSCOPIC MATERIALS

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

This invention relates to the use of polishing compounds and the prevention of surface oxidation of semiconductor films, and more particularly to surface oxidation preventatives and polishing compounds for aluminum antimonide thin films and similar hygroscopic materials.

Previous to the present invention there was no known method of polishing aluminum antimonide and preserving it in a state free of surface contamination caused by oxidation. The present invention now greatly extends the useful life of such semiconductor films.

Aluminum antimonide and other similar hygroscopic materials used in the field of optics such as prisms and lenses, which are made of soft crystals such as potassium bromide or sodium chloride are difficult to grind and polish since anhydrous solutions must be used as the hydraulic vehicle for the grinding and polishing grit and powders. Water can not be used in the hydraulic vehicle because it will cause dissolving, deformation, pitting or softening of the hygroscopic materials. Further, many anhydrous solvents which could be used to polish aluminum antimonide and the like have a characteristic of quickly deteriorating the wax lapping tools used for polishing. The present invention overcomes the disadvantages of other anhydrous solvents which could be used as hydraulic vehicles for the polishing grit or powder and at the same time provides a preservative coating which prevents surface oxidation on hygroscopic ferrous metals such as aluminum antimonide, and prevents excessive dissolving, deformation of surfaces and pitting and softening of highly hygroscopic materials such as potassium bromide, sodium chloride and other salt compounds which have a natural chemical affinity for absorbing moisture from the air.

The present invention also forms a protective anti-moisture film over the polished surfaces and can easily be removed with 200 proof alcohol.

It is an object of the invention, therefore, to provide a novel method for polishing hygroscopic materials and preventing the rapid surface oxidation thereof.

It is another object of the invention to provide the hydraulic vehicle for polishing grit and powders which will prevent the rapid oxidation formations on polished surfaces of hygroscopic ferrous metals.

It is a further object of the invention to provide a new polishing compound for polishing hygroscopic materials which will prevent rapid oxidation of the polished surfaces, prevent excessive dissolving, deformation, pitting and softening of the hygroscopic materials which have a natural chemical affinity for absorbing moisture from the air.

Still another object of the invention is to provide a protective anti-moisture coating for polished surfaces of hygroscopic materials.

A still further object of the invention is to provide a novel polishing compound for hygroscopic materials that will not attack the wax lapping tools used for polishing.

Other objects and many of the attendant advantages of this invention will become readily appreciated as the same

becomes better understood by reference to the following detailed description:

In the polishing of semiconductor films, such as aluminum antimonide, which quickly oxidize when exposed to the air because of the natural affinity for absorbing moisture from the air, it is necessary to use an anhydrous hydraulic vehicle for the grinding and polishing abrasive powders. Semiconductors such as aluminum antimonide quickly oxidize when exposed to the air; therefore, the polished surface of such semiconductors must be protected in order to prevent surface contamination caused by oxidation. While almost every type of water-free compound can be used as a hydraulic agent, all, except ethylene glycol will attack beeswax, crystalline wax, burgundy wax, and micro-pitch wax used on the lapping tools for polishing these materials. Ethylene glycol when used as the hydraulic vehicle for the polishing grit and powders will form a protective anti-moisture film over the polished surfaces and thus extend the useful life of the semi-conductor films.

Anhydrous solutions of ethylene glycol with grinding and polishing grit and powders permit an easy method of polishing hygroscopic materials that are used almost exclusively in the field of optics. Using the polishing compound of the present invention, potassium bromide, sodium chloride and other salt compounds can be ground and polished without dissolving, deforming, pitting or softening of the materials and without harm to the wax lapping tools.

It was determined by experimentation that ethylene glycol was the only hydraulic vehicle for the grinding and polishing powders that was compatible to both the hygroscopic materials being polished and the associated wax lapping tools used in the polishing process.

There are a number of known polishing compounds which use ethylene glycol as an ingredient, however, every one of these known compounds would have a very corrosive effect upon the hygroscopic materials being polished since these prior compounds either contain water, soaps, oils, fatty acids or other corrosive ingredients, or a combination thereof.

Therefore a composition comprising a mixture of powdered dehydrated abrasive material and ethylene glycol, in varying proportions depending on the type and nature of the surface to be polished can successfully be used to polish hygroscopic semiconductor materials and the like as mentioned above. The abrasive material may be any of a variety of dry polishing, buffing or lapping abrasives suitable for grinding or polishing hygroscopic ferrous metals such as aluminum antimonide and other hygroscopic materials such as potassium bromide, sodium chloride and other salt compounds. A few typical well known, inert abrasive powders used for polishing semiconductors are disclosed in Transistor Technology, vol. I, by H. E. Bridgers et al., D. Van Nostrand Co., Inc., Princeton, N.J., 1958 (page 317). With the aforementioned type polishing composition using ethylene glycol as a hydraulic vehicle aluminum antimonide has been surface polished to a thickness of 0.013 of an inch with mirror-like polished surfaces remaining in that state even after a long period of time without any visible discoloration caused by surface oxidation.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. A method for polishing hygroscopic ferrous metals and forming a protective surface coating thereon consisting:

(a) applying to a wax lapping to a water-free composition compatible with said lapping tool and consisting of a mixture of an anhydrous hydraulic vehicle and a dehydrated abrasive powder in proportions depending on the type and nature of the hygroscopic surface to be polished, said hydraulic vehicle also being unharmful to said wax lapping tool,

(b) said hydraulic vehicle consisting entirely of ethylene glycol which will not soften and deform hygroscopic materials,

(c) said abrasive powder mixed with said ethylene glycol being any of a variety of polishing, buffing and lapping abrasives suitable for grinding and polishing hygroscopic materials and entirely free of water,

(d) contacting the lapping tool with polishing composition thereon to the surface of a hygroscopic ferrous metal until polished to a mirror-like surface,

(e) washing said surface with ethylene glycol to remove excess abrasive,

(f) forming an anti-moisture film over the polished surface of the hygroscopic ferrous metal with said ethylene glycol during and by the polishing and washing of said surface for preventing contamination of said surface by oxidation thereof.

2. A method for polishing hygroscopic materials such as, aluminum antimonide and other hygroscopic metals, potassium bromide, sodium chloride and other salt compounds which have a natural chemical affinity for absorbing moisture from the atmosphere, thin semiconductor films and hygroscopic materials used in the field of optics and forming a protective surface coating thereon consisting:

(a) applying to a polishing tool a water-free composition compatible with said lapping tool and consisting

of a mixture of an anhydrous hydraulic vehicle and a suitable dehydrated abrasive powder in proportions depending on the type and nature of the hygroscopic material to be polished, said hydraulic vehicle also being unharmful to said lapping tool,

(b) said hydraulic vehicle consisting entirely of ethylene glycol which will not soften and deform hygroscopic materials,

(c) said abrasive powder being any of a variety of well known polishing, buffing, and lapping abrasives suitable for polishing soft hygroscopic crystals and entirely free of water,

(d) contacting the polishing tool with said polishing composition thereon to the surface of the hygroscopic material until polished to a bright surface,

(e) washing said surface with ethylene glycol to remove excess abrasive,

(f) forming a protective film over the polished surfaces of the hygroscopic material with said ethylene glycol during and by the polishing and washing of said surface for preventing oxidation, excessive dissolving, deformation, pitting and softening of the hygroscopic materials.

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