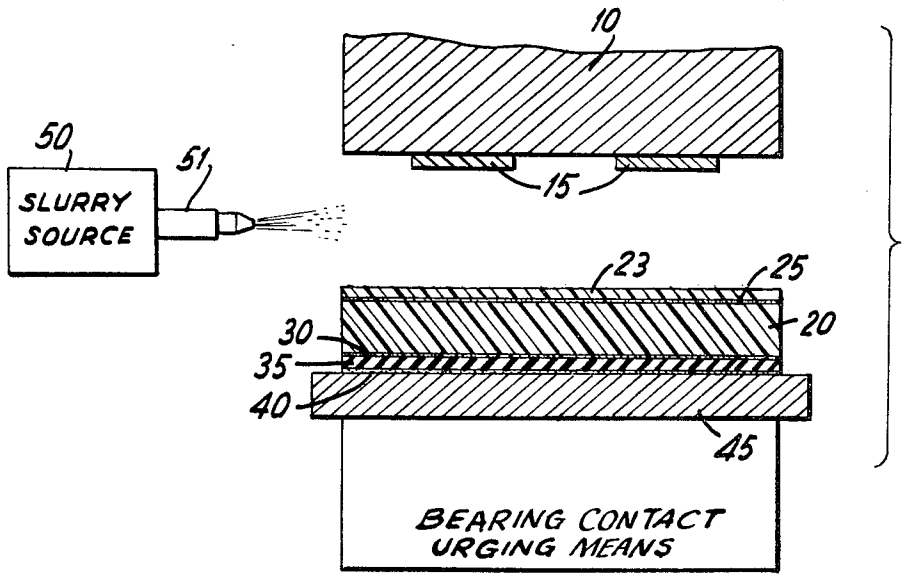
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POLISHING APPARATUS

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POLISHING APPARATUS

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ABSTRACT OF THE DISCLOSURE

A device for polishing semiconductor wafers wherein the polishing tool comprises a poromeric material of polyurethane reinforced with a polyester and with a polishing slurry thereon is urged into contact with the workpiece.

This invention relates to an apparatus for processing workpieces and, more specifically for imparting a polished finish to elements subjected thereto.

Many applications of present day interest require thin, fragile semiconductor wafers having a highly polished critical surface. To produce such a finish, prior art organizations have rotated such semiconductor elements against a lapping substrate in the presence of a polishing slurry.

The surface of the lapping plate in contact with the semiconductor elements has typically included thereon as the active polishing member a pitch composition, papers, pseudo papers or other nonwovens, or felt substances. However, the above and other prior art operative polishing surfaces are characterized by at least several of the following deficiencies: (1) temperature sensitivity, and therefore instability at high polishing rates; (2) unhomogeneous consistency; (3) a propensity to pick up and retain foreign elements; (4) poor wear characteristics requiring frequent replacement; (5) variations from sample to sample; (6) the characteristics of being impermeable, and thereby preventing a polishing slurry from reaching all surface areas of a product being operated upon; (7) relatively little tensile strength, thereby being subject to distortion; and (8) a resistance to bonding, thereby being difficult to affix to cooperating compositions and/or a lapping plate.

It is therefore an object of the present invention to provide an improved apparatus for polishing workpieces.

More specifically, an object of the present invention is the provision of a resilient, homogeneous polishing organization which is porous, relatively insensitive to temperature, and which may be fabricated with little variation from sample to sample.

These and other objects of the present invention are realized in a specific illustrative polishing organization which comprises a layer of Corfam (a trademark of the Du Pont Corporation for a poromeric material) affixed to a lapping substrate via layers of an adhesive, chemically inert nitrile rubber, and a pressure sensitive, clean release adhesive. A poromeric material, such as Du Pont's Corfam, comprises polyurethane reinforced with polyester. In this regard see, for example, "Chemistry of Organic Compounds" by C. R. Noller, published by W. B. Saunders Company in 1965, at chapter 36.

The active, or free Corfam surface is adapted to be flat such that the surface of the work elements brought into rotational bearing contact therewith will be polished, i.e., will be rendered flat. In an alternative embodiment of the present invention a porous film e.g., of foam polyurethane, is attached to the Corfam to function as the active polishing surface.

A complete understanding of the present invention and of the above and other objects thereof may be gained

from a consideration of an illustrative embodiment thereof depicted in the accompanying drawing.

Referring now to the drawing, there is shown in cross-sectional form an illustrative polishing organization which embodies the principles of the present invention. The arrangement includes a layer of Corfam **20** which has a layer **35** of a chemically inert material, e.g., nitrile rubber, affixed thereto by an adhesive **30**. A layer **40** of a pressure sensitive, clean release adhesive **40** is bonded to the bottom of the nitrile rubber layer **35** for purposes of facilitating the attachment and removal of the composite polishing laminated structure with respect to a metal lapping substrate **45**. It is noted that other poromeric materials, as well as other compositions embodying the attributes of Corfam described herein, may be employed in place of the Corfam layer **20**.

The Corfam layer **20** is fabricated such that the upper surface thereof exhibits the requisite flatness required for a particular polishing operation (assuming that a flat surface is desired for the workpiece). Employing such a layer **20**, the lapping substrate **45** is urged into a bearing pressure contact with elements **15** to be polished. Such elements **15** may comprise, for example, semiconductor wafers, with these elements being shown in the drawing as mounted on a rotating mounting block **10**. Further, the polishing operation may advantageously take place in a polishing liquid slurry environment, with the slurry being supplied by a slurry source **50** via a nozzle **51**.

The Corfam material **20** is very porous, and hence the slurry is translated by the layer **20** to all portions of the surface of the elements **15** thereby effecting uniform polishing. Also, the Corfam material **20** is essentially insensitive to temperature, at least in the temperature range of interest for polishing operations. Accordingly, polishing may be accomplished at high rates of speed. Further, the layer **20** is homogeneous, and may be fabricated in relatively large quantities to produce many uniform polishing layers without material variation from element to element.

Moreover, Corfam is resilient and prevents damage to elements **15** being polished by absorbing mechanical vibrations and any compaction caused by overshoot of the mounting members **10** or **45**. In addition, the layer **20** is durable which is beneficial from maintenance and batch processing rate standpoints.

Still further, the active, upper surface of the Corfam layer **20** can be treated or impregnated when required for special polishing operations. Such treatment may comprise, for example, brushing, napping, skiving or texturing the polishing Corfam surface to increase the number for active polishing fibers, or calendering the surface to increase its flatness.

The composite laminated polishing organization **20–30–35–40** is easily attached to, and removed from the lapping substrate **45** by reason of the properties of the pressure sensitive, clean release adhesive layer **40**. The inert layer **35** is employed to insulate the adhesive **40** from the layers thereabove, and also from the slurry which would otherwise reach the adhesive **40** through the porous Corfam layer **20**. Such foreign substances would tend to change the physical state of the adhesive **40**, e.g., harden it thereby making attachment to and removal from the plate **45** more difficult.

By way of functional operation, when rotational bearing contact is established between the Corfam upper surface and the work pieces **15**, the desired polishing surface is imparted to the lower, critical surface of these elements. Hence, the desired polishing is accomplished.

In an alternative embodiment of the invention a porous film **23**, e.g., of foam polyurethane, is affixed to the upper surface of the Corfam layer **20** by a porous adhesive **25**. In such an arrangement, the upper face of the film **23** is

the effective polishing surface, with the Corfam backing layer **20** providing resiliency and strength, while maintaining a composite porous organization which is desirable in a polishing organization for the reasons given hereinabove. Thus it is noted that compositions which are porous only in film thicknesses, but which otherwise have desirable polishing properties, may be used as a polishing surface when mounted on a Corfam backing layer **20**.

Thus, the organization shown in the drawing, both with and without the film **23** and the adhesive **25**, has been shown by the above to function as a very desirable polishing structure.

It is to be understood that the above described method and organizations are only illustrative of the application of the principles of the present inventions. Numerous other arrangements and modes of operation may be devised by those skilled in the art without departing from the spirit and scope of this invention. For example, the active polishing surface, i.e., the upper surface of the Corfam **20** or the film **23** if such a film is employed, may exhibit a geometry other than a flat plane when a non-flat work piece of a corresponding geometry is to be polished. In addition, other known bonding mechanisms, such as mechanical interlocking or distortion, may be used to fabricate the composite laminated polishing structure shown in the drawing without the use of the adhesives **25** and **30**.

We claim:

1. In combination in a polishing organization, a poromeric material comprising polyurethane reinforced with polyester, a porous film affixed to said poromeric material, wherein said poromeric material has first and second surfaces, said first surface engaging said porous film, and further comprising an inert layer of nitrile rubber affixed to said second surface of said Corfam.

2. In combination in a polishing organization, a poromeric material comprising polyurethane reinforced with polyester, a porous film affixed to said poromeric material, a pressure sensitive, clean release adhesive affixed to said poromeric material, a lapping plate, said poromeric material, and said adhesive being mounted on said lapping plate, and means for selectively urging work pieces to be polished into a bearing relationship with said lapping plate.

3. In combination in a polishing organization, a poromeric material comprising polyurethane reinforced with polyester, a porous film affixed to said poromeric material, wherein said porous film is polyurethane, and means for selectively urging work pieces to be polished into bearing contact with said porous film.

4. In combination in a polishing organization, a lapping substrate, a poromeric layer comprising polyurethane reinforced with polyester mounted on said substrate, said poromeric layer including a polishing surface thereon, and means for urging work pieces to be polished into bearing contact with said poromeric polishing surface.

References Cited

UNITED STATES PATENTS

2,644,280	7/1953	O'Neil	51—406
3,050,909	8/1962	Rawstron	51—124
3,082,582	3/1963	Jeske	51—407 X
3,123,953	3/1964	Merkl	51—283
3,360,889	1/1968	Borish	51—131 X
671,130	4/1901	Darden	51—401
804,853	11/1905	Ireson.	
1,923,719	8/1933	Fuller	51—301 X
2,650,158	8/1953	Eastman	51—407 X

FOREIGN PATENTS

681,832	3/1964	Canada.

OTHER REFERENCES

"Boot and Shoe Recorder," Oct. 1, 1963, article titled "The Story of 'Corfam' . . . ," pages 1–2 thereof.

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