

POLISHING PAD

5 The invention relates to a polishing pad having a transparent window through which an optical beam is transmitted for an optical apparatus to detect the status of a workpiece during a polishing operation.

10 U.S. Patent 5,893,796 discloses a polishing pad for use with a polishing fluid, the polishing pad having, a polishing layer and a window in an opening through the polishing layer. The window transmits an optical beam for detection of the presence or absence of a thickness of material being removed from a semiconductor wafer by a CMP
15 polishing operation. One of the problems to be faced is to prevent polishing fluid from leaking beyond the polishing layer and, thereby, cause optical interference with the optical beam being transmitted by the window. To prevent leakage, an adhesive seal is imbedded in the opening between
20 the window and the fluid impermeable layer. However, the seal can be defective by having a leakage path due to a small void or gap in the adhesive seal. Further, the polishing pad is thin and, thereby, is easily bent, which tends to develop a crack or separation of the adhesive from
25 the sides of the opening due to bending during routine handling of the polishing pad, or due to exertion of polishing pressure during use of the polishing pad.

30 The invention resides in a polishing pad for use with a polishing fluid, wherein the polishing pad has, a polishing layer, a window in an opening through the polishing layer, and a fluid impermeable layer spanning across the polishing layer and the window and the opening to provide an uninterrupted continuous barrier to leakage of polishing fluid, the fluid impermeable layer having thereon an
35 adhesive that forms bond seals with the polishing layer and the window.

An advantage is that the fluid impermeable layer 40, being uninterrupted, avoids a tendency to produce leakage paths due to bending during routine handling, or due to exertion of polishing pressure during use of the polishing pad, or due to small voids or gaps in an adhesive. A further
5 advantage is that the bond seals minimizes wetting by the polishing fluid of the interface between the adhesive 41 and each of the polishing layer 10, the window 30 and the fluid impermeable layer 40.

10 The invention will now be described by way of example with reference to the accompanying drawings wherein:

Fig. 1 is a top plan view of a polishing pad having a transparent window;

15 Fig. 2 is an enlarged cross-sectional view through a portion of a polishing pad having a transparent window and an unsuccessful seal; and

Fig. 3 is an enlarged cross-sectional view of a portion of the polishing pad disclosed in Fig. 1, further disclosing a transparent window and an uninterrupted seal according to
20 the invention.

As shown in Fig. 2, an unsuccessful, polishing pad is a two layer pad that includes an upper polishing layer (10) of IC1000 material and a lower backing layer (20) of Suba IV material, both of which materials are made by Rodel, Inc. A
25 transparent window (30) is made from a piece of optical transmissive polymeric material which is installed in an opening (16) in the polishing layer (10) of the polishing pad. An opening (18) in the lower layer (20) is aligned with and is smaller than the opening (16), thereby forming a
30 ledge (26) that served as a seat for the window (30). A seal was attempted between the window (30) and the ledge (26), which would prevent polishing fluid, in the form of slurry and/or de-ionized water, from leaking past the window (30) and causing interference with an optical beam from optical
35 equipment. Previously, a seal was attempted to be established between the window (30) and the ledge (26) by an adhesive film (32) configured with a cutout (34) which

matched the opening (18) in the lower layer (20), and the window (30) was sealed by the adhesive seal overlying the ledge (26) on the lower layer (20). However, leakage could still occur if the adhesive seal was defective with small voids or gaps in the adhesive, or became damaged as could occur by bending the polishing pad and by exertion of polishing pressure during routine handling and use of the polishing pad.

The invention will be described with reference to Fig. 3. According to an embodiment, the invention provides a polishing pad having a polishing layer (10), and a window (30) in an opening (16) through the polishing layer (10), which are covered by an underlying, continuous, optically transmissive, fluid impermeable layer (40) having adhesive (41) that forms bond seals with the polishing layer (10) and the window (30). The bond seals resist wetting by the polishing fluid of an interface between the adhesive (41) and each of, the polishing layer (10) and the window (30) and the fluid impermeable layer (40).

Another embodiment of the polishing pad (10) according to the invention comprises, a lower backing layer (20), together with, a polishing layer (10) and a window (30) in an opening (16) through the polishing layer (10), which are covered by, and bond sealed to adhesive (41) on both, opposite sides of an underlying, fluid impermeable layer (40). The adhesive (41) on the both sides forms bond seals with the lower backing layer (40), the polishing layer (10) and the window (30). The backing layer (20) has a top face (22) and a bottom face (24). The bond seals resist wetting by the polishing fluid of an interface between the adhesive (41) and each of, the polishing layer (10), the window (30), the fluid impermeable layer (40) and the backing layer (20). The polishing layer (10) and the backing layer (20) are adhered together by the fluid impermeable layer (40) which includes adhesive (41).

The polishing layer (10) is a layer of IC1000 material, and the backing layer 20 is a layer of Suba IV material,

both of which materials are made by Rodel, Inc., of Newark, Delaware. The polishing layer (10) has a top polishing face (12) and a bottom face (14).

The polishing layer (10) and the backing layer (20) are substantially opaque. A transparent window (30) is disposed in an opening (16) in the polishing layer (10). The transparent window (30) is made of an optically transmissive, or light-transmissive, material to permit an optical beam from a known optical equipment or apparatus to pass through the polishing pad while the polishing pad is being used for polishing a workpiece (not shown). An optically transmissive material is known from U.S. Patent 5,893,796.

The opening (16) extends through the thickness of the polishing layer (10) from the polishing face (12) to the bottom face (14), and the transparent window (30) lies in the opening (16) within this thickness. The opening (16) is axially aligned above an opening (18) extending through the thickness of the backing layer (20) from the top face (22) to the bottom face (24).

The opening (18) is smaller in circumference than the circumference of the opening (16). The backing layer (20) around a periphery of the opening (18) forms a circumferential ledge (26) that serves as a seat for the transparent window (30) and the fluid impermeable layer (40).

According to the invention, the fluid impermeable layer (40) is uninterrupted as it spans an area between the openings (16) and (18) beneath the transparent window (30). By uninterrupted it is meant that the fluid impermeable layer (40) is continuous without an aperture or passageway through which polishing fluid could flow through the layer (40) from the opening (16) to the opening (18).

For example, the fluid impermeable layer (40) comprises a flexible, thin film of optically transmissive hydrophobic polymeric material that is used in minimized thickness to maximize its optical transparency, such as,

polyethyleneterephthalate, which is coated with a thin layer of the adhesive (41) on its opposite major surfaces.

The adhesive (41) is a pressure sensitive adhesive that is hydrophobic, and that is used in minimized thickness to maximize its optical transparency, for example, a synthetic rubber based adhesive known as Rodel, Inc., of Newark, Delaware, and known as 3M442 commercially available from 3M Company, Minneapolis, Minnesota, USA, and further, for example, an acrylic based adhesive known as Rodel PSA V, Adchem 2019, commercially available from Rodel, Inc. of Newark, Delaware, and further for example, a metal-free acrylic adhesive known as, Rodel PSA VII, Adhesive Research Development 8049-28, commercially available from Rodel, Inc. of Newark, Delaware, and further for example, a metal-free acrylic adhesive known as, Rodel PSA VII, Adhesive Research Development 8119-28, commercially available from Rodel, Inc. of Newark, Delaware. Further, for example, the fluid impermeable layer (40) is fabricated as a film with opposite sides having adhesive (41) permanently adhered to the film, and the adhesive (41) on each of the opposite sides being covered and protected by a peel away covering film, not shown.

The peel away covering film is removed to expose the adhesive (41) on the fluid impermeable layer (40) for application in contact with the bottom face (14) of the polishing layer (10) and the entire bottom surface of the transparent window (30). Pressure is applied to thereby adhere the adhesive (41) to the polishing layer (10) and the window (30) with a water repellant, hydrophobic bond seal. In particular, the adhesive (41) adheres to the bottom face (14), and circumscribes around a periphery of the cutout (16), and also adheres to the entire bottom surface of the transparent window (30). The adhesive (41) on the bottom of the fluid impermeable layer (40) is exposed by removal of the peel away covering film, to adhere the polishing pad to a platen of a known polishing machine, not shown, or to

adhere the polishing pad to a backing layer (20), in turn, mounted to a platen of a known polishing machine.

According to an embodiment, the invention provides a polishing pad having a polishing layer (10), and a window (30) in an opening (16) through the polishing layer (10), which are covered by, and bond sealed to, an underlying, fluid impermeable layer (40) having adhesive (41) on both sides. Polishing fluid, such as slurry or de-ionized water, is delivered to the polishing face (12). The fluid impermeable layer (40) that is adhesively bond sealed to the undersurfaces of the polishing layer (10) and the transparent window (30), serves as an uninterrupted continuous, fluid impermeable barrier to polishing fluid that leaks into the opening (16) around the transparent window (30) or that leaks beneath the polishing layer (10).

If there is any gap in the bond seal provided by the adhesive (41) with either the polishing layer (10) or the window (30), any polishing fluid which leaks through such a gap will be contained against an uninterrupted continuous, fluid impermeable barrier provided by the fluid impermeable layer (40) that covers and spans across the opening (16) and the back face (14) of the polishing layer (10) and the back side of the window (30).

The uninterrupted fluid impermeable layer (40) eliminates reliance upon a previously used seal imbedded in the opening (16) between the window (30) and the polishing layer (10).

**Claims:**

1. A polishing pad for use with a polishing fluid comprises, a polishing layer, a window in an opening through
5 the polishing layer, and a seal preventing leakage of the polishing fluid beyond the polishing layer, characterised in that;

the seal is a fluid impermeable layer (40) having thereon an adhesive (41) forming bond seals with the
10 polishing layer (10) and the window (30), the fluid impermeable layer (40) spanning across the polishing layer (10) and the window (30) and the opening (16), and the fluid permeable layer (40) being uninterrupted and providing a continuous barrier to leakage of polishing fluid.

15 2. The polishing pad of claim 1, further characterised by; a backing layer (20) adhered to the fluid impermeable layer (40) on an opposite side from the polishing layer (10), and an opening (18) through the layer (40) aligned with the opening (16) through the polishing layer (10).

20 3. The polishing pad of claim 2 wherein, the backing layer (20) around a periphery of the opening (18) through the backing layer (40) forms a circumferential ledge (26) that serves as a seat for the window (30) and the fluid impermeable layer (40).

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