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(54) **MULTIPLE POLYMER BELT USED AS A CARRIER IN A LINEAR BELT POLISHING SYSTEM**

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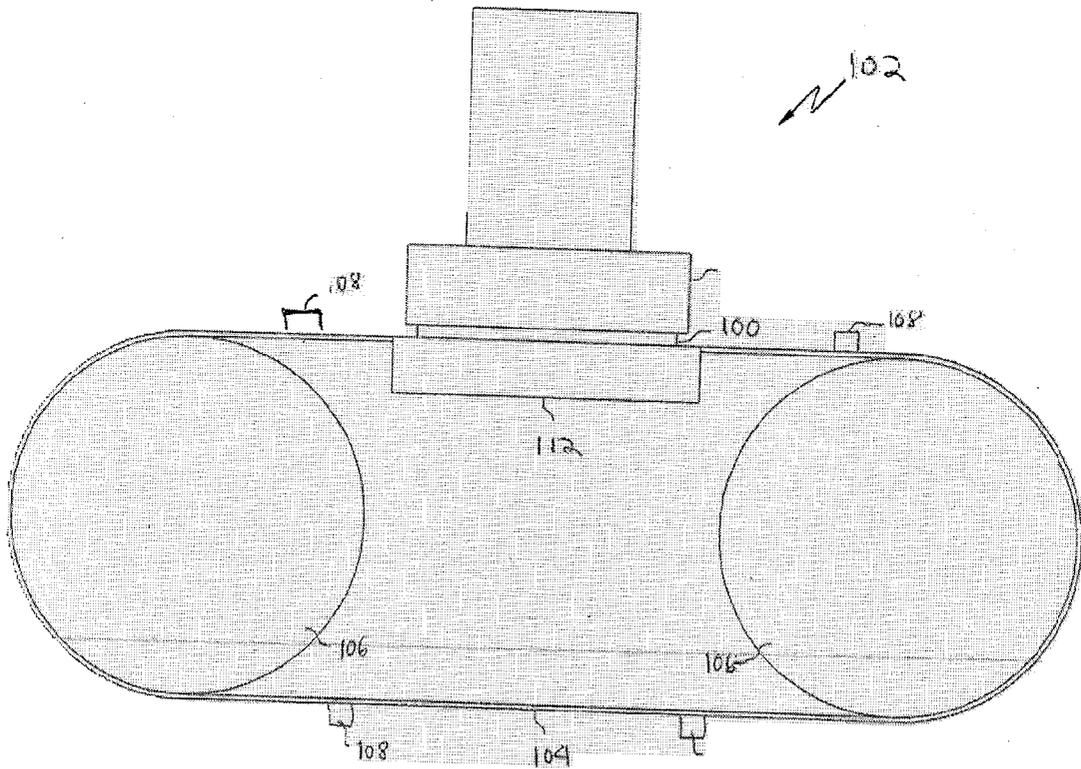
(57) **ABSTRACT**

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A support belt to be used with a polishing belt. The support belt includes an interior layer made of a polymer, wherein said interior layer has a first free end and a second free end that about one another but are not attached to one another so as to form a first seam and an adhesive placed on an exterior surface of the interior layer. An exterior layer made of a polymer and attached to the adhesive, wherein the exterior layer has a first free end and a second free end that about one another but are not attached to one another so as to form a second seam.

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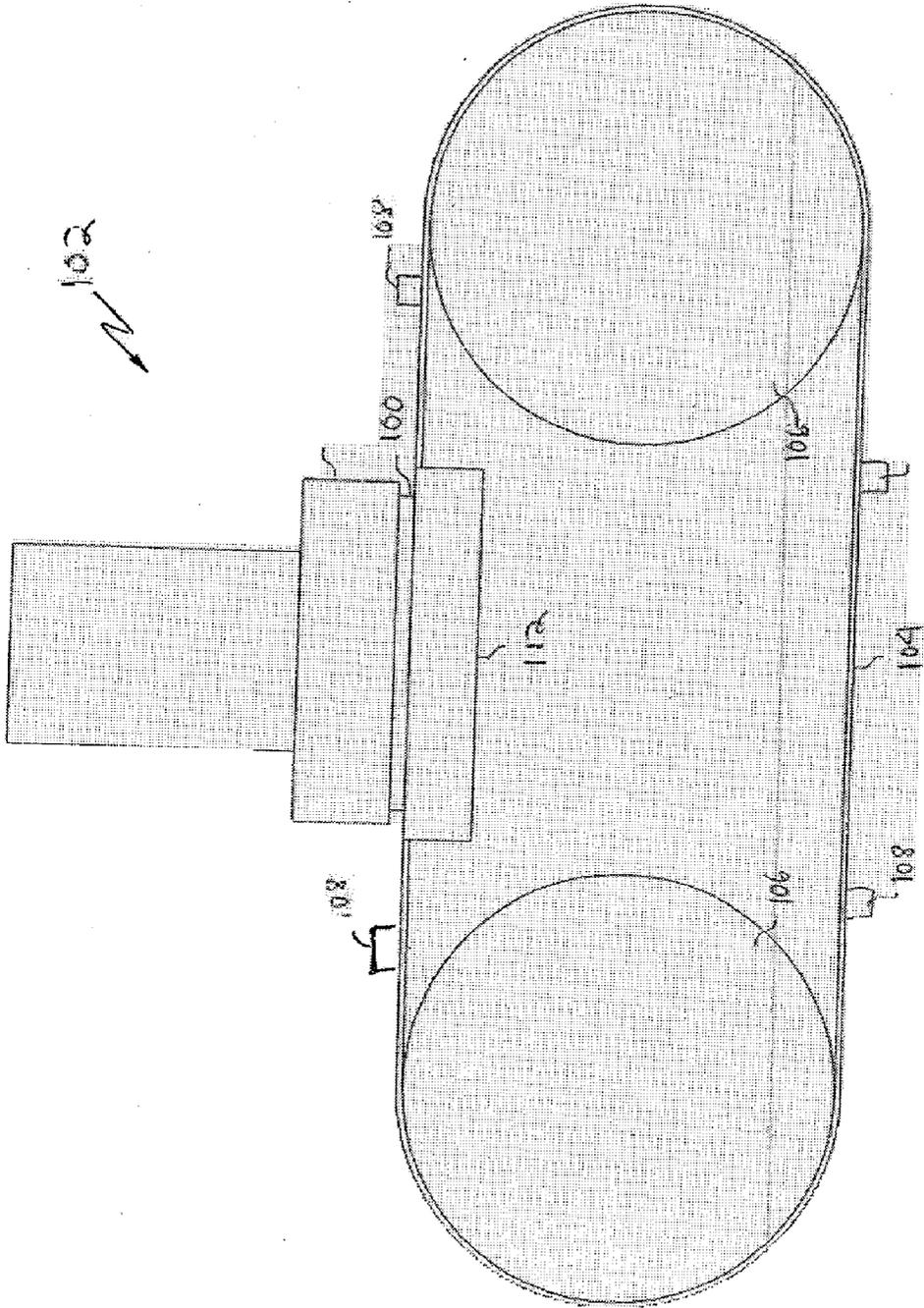


FIG. 1

FIG 2

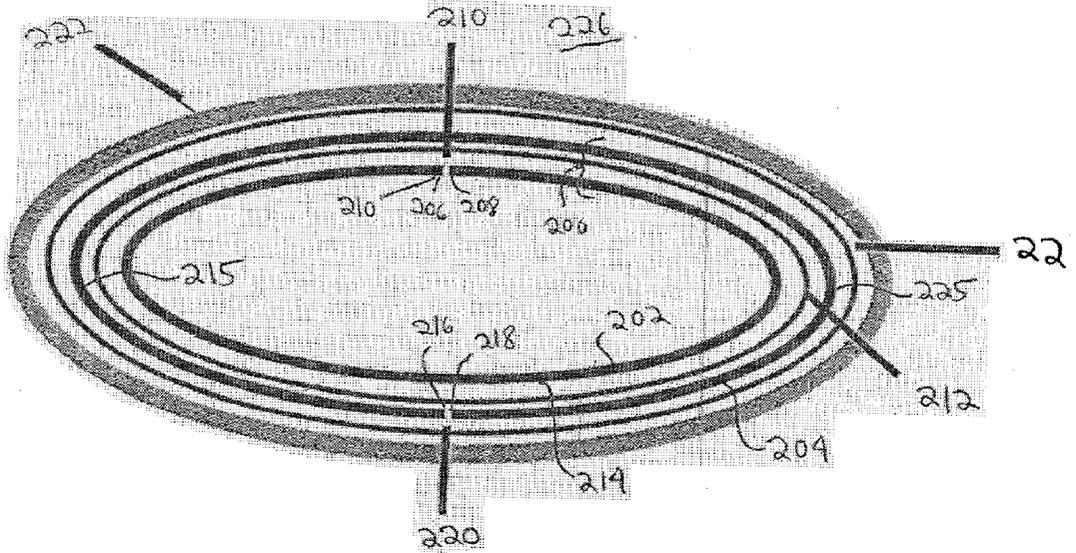
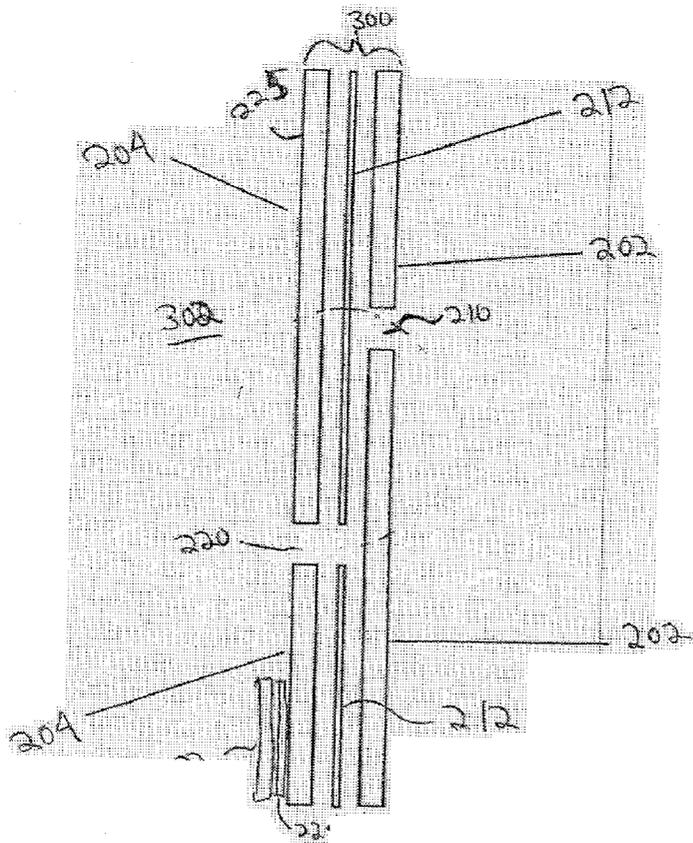


FIG 3



## MULTIPLE POLYMER BELT USED AS A CARRIER IN A LINEAR BELT POLISHING SYSTEM

### BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention regards a polishing pad and belt for polishing and planarizing semiconductor substrate surfaces.

[0003] 2. Discussion of the Related Art

[0004] As shown in FIG. 1, it is well known in the art to finely polish and planarize semiconductor substrates or semiconductor wafers 100 using chemical mechanical polishing (CMP) processes. Many of these polishing CMP processes use a polishing system 102 that includes a polishing belt 104. As shown in FIG. 1, the polishing system 102 includes a polishing belt 104 that is configured to revolve over a plurality of belt rollers 106. One or more polishing pads 108 (not to scale in FIG. 1) are adhered to the continuous belt 104. In the case of using a single polishing pad, the polishing pad is formed so as to cover the entire exterior surface of the continuous belt. In the case of using multiple polishing pads, multiple, individual pad sections are positioned adjacent to one another across the exterior surface of the belt.

[0005] In operation, one or more semiconductor wafers are positioned adjacent to and held against the polishing pad(s). The polishing system 102 further includes a semiconductor support 110 that is operative to place a semiconductor wafer 100 adjacent the polishing pad 108 and belt 104 of the present invention. The polishing system 102 further includes a base 112 on the opposite side of the pad 108 and belt 104 as the semiconductor wafer 100. The base 112 is operative to prevent the relatively planer surface of the pad 108 and belt 104 that is adjacent the semiconductor wafer 100 from being deformed by the downward force of the semiconductor support 110.

[0006] As the belt revolves, the polishing pad moves to polish and planarize the semiconductor wafers. There are several requirements for a belt to ensure efficient polishing of semiconductor wafers. One requirement is that the belt is strong so as to endure a large number of polishing cycles without wearing out. Steel belts have been used in the past as an attempt to provide such strength. Such steel belts were formed from a single sheet where the ends were welded to each other to form the belt. One problem with such steel belts was that one or more welding seams were formed at the areas of attachment. Such seams were contrary to a second requirement of polishing belts: the belt must maintain a flat surface during the polishing surface in order to insure adequate polishing of the semiconductor wafers.

[0007] As an attempt to overcome the above noted deficiencies of steel belts, there have been attempts at devising a belt that is both strong and seamless. Such belts have included multiple polymer layers formed in the shape of a belt where fibers/fabrics may or may not be used to provide reinforcement for the polymer layers. Such belts are formed by pouring the materials into a mold or the free ends of layer strips are welded to one another. Examples of such belts are disclosed in WO 99/06182, WO 24550, WO 01/15867, and U.S. Pat. No. 5,810,964, the entire contents of which are incorporated herein by reference. One disadvantage of such

molded polymeric belts is that the process for forming the belts is expensive and time consuming.

[0008] Another disadvantage of using welded polymer belts is that the height of the welded seam is often not uniform. In particular, using the latest welding techniques with high performance polymer sheets results in seams having a step height difference and/or a decrease in the strength and toughness of the seam. This can be a problem when a polishing material is placed on the belt without taking into consideration the inadequacies of the seam.

[0009] Another problem with welded polymer belts is that the welded bond is often not strong enough to be effective for chemical mechanical polishing processes and systems.

### SUMMARY OF THE INVENTION

[0010] One aspect of the present invention regards a support belt to be used with a polishing belt. The support belt includes an interior layer made of a polymer, wherein said interior layer has a first free end and a second free end that abut one another but are not attached to one another so as to form a first seam and an adhesive placed on an exterior surface of the interior layer. An exterior layer made of a polymer and attached to the adhesive, wherein the exterior layer has a first free end and a second free end that abut one another but are not attached to one another so as to form a second seam.

[0011] A second aspect of the present invention regards a polishing belt that includes a support belt that has an interior layer made of a polymer, wherein the interior layer has a first free end and a second free end that abut one another but are not attached to one another so as to form a first seam. The support belt further includes an adhesive placed on an exterior surface of the interior layer and an exterior layer made of a polymer and attached to the adhesive, wherein the exterior layer has a first free end and a second free end that abut one another but are not attached to one another so as to form a second seam. The polishing belt further including a polishing material is deposited on a surface of the exterior layer that faces away from the adhesive.

[0012] A third aspect of the present invention regards a polishing system that includes a material to be polished and a polishing belt that moves relative to the material and polishes the material as the polishing belt moves. The polishing belt includes a support belt having an interior layer made of a polymer, wherein the interior layer has a first free end and a second free end that abut one another but are not attached to one another so as to form a first seam, an adhesive placed on an exterior surface of the interior layer and an exterior layer made of a polymer and attached to the adhesive, wherein the exterior layer has a first free end and a second free end that abut one another but are not attached to one another so as to form a second seam. A polishing material is deposited on a surface of the exterior layer that faces away from the adhesive.

[0013] The first two aspects of the present invention provide the advantage of providing a polishing belt that inexpensive and easy to manufacture.

[0014] Each of the aspects of the present invention provides the advantage of providing polymer belt that has a uniform surface and has adequate strength and toughness at

a seam so that it can be effectively used in chemical mechanical polishing processes and systems.

[0015] Further advantages, as well as details, of the present invention ensue from the following description of a preferred embodiment, making reference to the drawings.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0016] FIG. 1 is a side view of a known polishing system that uses a known polishing belt;

[0017] FIG. 2 is a schematic side view of a first embodiment of a polishing belt with polishing material according to the present invention to be used with the polishing system of FIG. 1; and

[0018] FIG. 3 is schematic exploded view of a portion of a second embodiment of a polishing belt with polishing material according to the present invention to be used with the polishing system of FIG. 1.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0019] As shown in FIG. 2, one embodiment of a support belt 200 according to the present invention includes an interior layer 202 made of a polymer, such as Mylar, and an exterior layer 204 made of a polymer also, such as Mylar. The interior and exterior layers 202 and 204 are preferably identical in shape defining a rectangle having a length of approximately 93.25", a width of approximately 13" and a thickness ranging from 7 mil to 14 mil, preferably approximately 14 mil. The polymers used for the layers 202, 204 preferably have a high tensile modulus and have a stretch resistance such that they do not require reinforced internal layers, such as fibers, metal wires or woven carcass, that are often used in conventional molded polymeric belt polishing pads. Note that while it is preferred that the polishing belt does not use reinforcing materials, it is possible to adapt the polishing belt so that one or both of the layers 202, 204 are steel reinforced such as by using metal wire. Such reinforcement would make the polishing belt stretch resistant during stress situations and would also require layers 202, 204 to be thickened.

[0020] The polishing belt is formed by placing the two free ends 206, 208 of the interior layer 202 adjacent to one another as shown in FIG. 2. The free ends 206, 208 abut one another so as to define a linear "butted" seam 210. Such a butted seam includes the cases where the free ends 206, 208 touch one another or the free ends 206, 208 are separated from one another by a gap that ranges from zero to a maximum of 3/32". At this stage, an adhesive 212 is placed over the entire exterior surface 214 of the interior layer 202. The adhesive 212 is a high shear adhesive preferably in the form of a roll, such as the adhesives known by the trade names Adchem 7332, Adchem 1666-2, Adchem 732, Adchem 728, PSA5, PSA12 and VHB. After the adhesive 212 is attached to the interior layer 202, a surface 215 of the exterior layer 204 is placed on the surface of the adhesive 212 facing away from the exterior surface 214 of the interior layer 202 so that the exterior layer 204 is attached to the adhesive 212. The adhesive 212 covers the entirety of the surface 215. The free ends 216, 218 of the exterior layer 204 abut one another to form a linear butted seam 220 that is similar in structure to the butted seam 210 described previ-

ously. As shown in FIG. 2, the seams 210 and 220 are opposite one another in that the seams 210 and 220 are displaced by 180° relative to one another. The displacing of the seams 210 and 220 in this manner allows for the full amount of shear to take place for the support belt 200. Note that other displacements of the seams 210 and 220 are possible where the displacements range from 180° to a minimum displacement. Preferably, the minimum displacement between the seams is approximately 4" or 15.4°. The larger the displacement becomes with respect to the minimum displacement of 4" the less likely the seams will move at the same time.

[0021] Besides providing a full amount of shear, the support belt 200 provides other advantages. For example, the use of butted seams that are opposite one another allows for a uniformly thick belt even at the seams 210 and 220, where the free ends of the layers 202, 204 are not directly attached to one another and do not form raised areas, and so acts as a seamless belt. Another advantage is having the adhesive 212 cover the entire exterior surface 214 dramatically increases the shear strength of the belt when compared with the case of when the adhesive was applied only at the seams 210 and 220. Another advantage of the support belt 200 is that it does not require any altering of the belt material as far as cutting or grinding the areas around the seam in order to achieve a more uniform belt. The lack of cutting and grinding eliminates extra preparatory steps, which results in a simple design for the belt and a belt that is inexpensive to manufacture.

[0022] Another embodiment of a belt that enjoys many of the advantages of the support belt 200 is shown in FIG. 3. The support belt 300 has a structure that is similar to that of support belt 200 and so like numerals are used for like elements. In particular, interior layer 202, exterior layer 204 and the adhesive 212 are attached to one another in a manner similar to that described previously with respect to the support belt 200. The only differences are the dimensions of the layers 202, 204 and the seams 210 and 220 are displaced by a different amount. In particular, the layers 202, 204 each have a length of approximately 12", a width of approximately 0.5" and a thickness of approximately 14 mil. The seams 210 and 220 are displaced from one another by a distance of 4" which corresponds to a displacement of approximately 120° relative to one another. The displacing of the seams 210 and 220 in this manner allows for the full amount of shear to take place for the support belt 300.

[0023] After the support belts 200 and 300 are formed, a polishing material 222 is deposited on the exterior surface 224 of the exterior layer 204 by various known processes, such as ink jet printing and gravure/screen printing. Any known polishing material 222 may be used such as the material known by the trade name IC1000 made by Rodel. The polishing material 222 can be varied to meet a customer's needs. For example, specific different polishing materials are used for polishing oxide substrates and metal containing substrates. The polishing material 222 may be attached to layer 204 via an adhesive 224. Note that the combination of the support belts 200, 300 and the polishing material 222 is deemed to form a polishing belt 226, 302, respectively.

[0024] Other modifications are possible for the support belts 200 and 300. For example, sub-pads can be used in

addition to the polishing material **222**, such as the sub-pad known by the trade name SP2100 made by Rodel. The sub-pads are attached to the exterior surface **224** by an adhesive, such as the adhesives known by the trade names PSA5, PSA12 and PSA2.

[**0025**] After the polishing materials are attached to the belts **200** and **300**, the belts are installed in a polishing system such as the one described previously with respect to **FIG. 1**.

[**0026**] The foregoing description is provided to illustrate the invention, and is not to be construed as a limitation. Numerous additions, substitutions and other changes can be made to the invention without departing from its scope as set forth in the appended claims.

We claim:

**1.** A support belt to be used with a polishing belt, comprising:

an interior layer made of a polymer, wherein said interior layer has a first free end and a second free end that abut one another but are not attached to one another so as to form a first seam;

an adhesive placed on an exterior surface of said interior layer; and

an exterior layer made of a polymer and attached to said adhesive, wherein said exterior layer has a first free end and a second free end that abut one another but are not attached to one another so as to form a second seam.

**2.** The support belt of claim 1, wherein said polymer of said interior layer comprises Mylar.

**3.** The support belt of claim 2, wherein said polymer of said exterior layer comprises Mylar.

**4.** The support belt of claim 1, wherein no reinforcing internal layers are present.

**5.** The support belt of claim 1, wherein said first seam and said second seam are offset with respect to each other.

**6.** The support belt of claim 5, wherein said first seam and said second seam are displaced with respect to each other by an amount that ranges from approximately 15° to 180°.

**7.** The support belt of claim 6, wherein said amount is approximately 15°.

**8.** The support belt of claim 6, wherein said amount is approximately 180°.

**9.** The support belt of claim 1, wherein said adhesive is placed over the entirety of said exterior surface.

**10.** A polishing belt comprising:

a support belt comprising:

an interior layer made of a polymer, wherein said interior layer has a first free end and a second free end that abut one another but are not attached to one another so as to form a first seam;

an adhesive placed on an exterior surface of said interior layer; and

an exterior layer made of a polymer and attached to said adhesive, wherein said exterior layer has a first free end and a second free end that abut one another but are not attached to one another so as to form a second seam; and

a polishing material is deposited on a surface of said exterior layer that faces away from said adhesive.

**11.** The polishing belt of claim 10, wherein said polymer of said interior layer comprises Mylar.

**12.** The polishing belt of claim 11, wherein said polymer of said exterior layer comprises Mylar.

**13.** The polishing belt of claim 10, wherein no reinforcing internal layers are present.

**14.** The polishing belt of claim 10, wherein said first seam and said second seam are offset with respect to each other.

**15.** The polishing belt of claim 14, wherein said first seam and said second seam are displaced with respect to each other by an amount that ranges from approximately 15° to 180°.

**16.** The polishing belt of claim 15, wherein said amount is approximately 15°.

**17.** The polishing belt of claim 15, wherein said amount is approximately 180°.

**18.** The polishing belt of claim 10, wherein said adhesive is placed over the entirety of said exterior surface.

**19.** The polishing belt of claim 10, further comprising a sub-pad attached to said surface of said exterior layer that faces away from said adhesive.

**20.** A polishing system comprising:

a material to be polished;

a polishing belt that moves relative to said material and polishes said material as said polishing belt moves, wherein said polishing belt comprises:

a support belt comprising:

an interior layer made of a polymer, wherein said interior layer has a first free end and a second free end that abut one another but are not attached to one another so as to form a first seam;

an adhesive placed on an exterior surface of said interior layer; and

an exterior layer made of a polymer and attached to said adhesive, wherein said exterior layer has a first free end and a second free end that abut one another but are not attached to one another so as to form a second seam; and

a polishing material is deposited on a surface of said exterior layer that faces away from said adhesive.

**21.** The polishing system of claim 20, wherein said first seam and said second seam are offset with respect to each other.

**22.** The polishing system of claim 20, wherein said adhesive is placed over the entirety of said exterior surface.

**23.** The polishing system of claim 20, further comprising a plurality of belt rollers upon which said polishing belt revolves.

**24.** The polishing system of claim 20, wherein said material comprises a semiconductor wafer.

**25.** The polishing system of claim 20, further comprising:

a support that places said material adjacent to said polishing belt; and

a base positioned on an opposite side of said polishing belt as said material, wherein said base prevents a surface of said polishing belt adjacent said material from being deformed by a force generated by said support.

26. The polishing system of claim 24, further comprising:  
a support that places said semiconductor wafer adjacent to  
said polishing belt; and  
a base positioned on an opposite side of said polishing belt  
as said semiconductor wafer, wherein said base pre-

vents a surface of said polishing belt adjacent said  
semiconductor wafer from being deformed by a force  
generated by said support.

\* \* \* \* \*