# POLISHING PADS AND SYSTEMS AND METHODS OF MAKING AND USING THE SAME

## FIELD

The present disclosure relates to polishing pads and systems useful for the polishing of substrates, and methods of making and using such polishing pads.

## BACKGROUND

Polishing pads useful for polishing the surfaces of substrates, e.g. semiconductor wafer surfaces are known in the art, for example, PCT Publ. Appl. Nos. WO 2015/153597 A1 and WO 2015/153601 A1, U.S. Pat. Nos. 5,489, 233; 5,958,794 and 6,234,875.

## SUMMARY

In one embodiment, the present disclosure provides a polishing pad comprising:

i) a polishing layer having a working surface and a second surface opposite the working surface; wherein the working surface includes a land region and at least one of a plurality of precisely shaped pores and a plurality of precisely shaped asperities, the thickness of the land region is less than about 5 mm and the polishing layer comprises a polymer; ii) a porous substrate having a first major surface, an opposed second major surface and a plurality of voids, where, for at least one depth, some are filled with polymer and some are not filled with polymer and; iii) an interfacial region, the interfacial region being where a portion of the polymer of the polishing layer is embedded in a portion of the plurality of voids of the porous substrate. The polishing layer further includes at least one macro-channel, and the interfacial region aligns, through the thickness of the polishing pad, with the at least one macro-channel.

In another embodiment, the present disclosure provides a polishing pad including the previous polishing pad, wherein the porous substrate is at least one of a film substrate having at least one of a plurality of holes and a plurality of through holes, a woven or nonwoven substrate and an open cell foam. In some embodiments, the porous substrate does not include an open cell foam.

CLAIMS

1. A polishing pad comprising:

a polishing layer having a working surface and a second surface opposite the working surface; wherein the working surface includes a land region and at least one of a plurality of precisely shaped pores and a plurality of precisely shaped asperities, the thickness of the land region is less than about 5 mm and the polishing layer comprises a polymer;

a porous substrate having a first major surface, an opposed second major surface and a plurality of voids, where, for at least one depth, some are filled with polymer and some are not filled with polymer; and

an interfacial region, the interfacial region being where a portion of the polymer of the polishing layer is embedded in a portion of the plurality of voids of the porous substrate;

wherein the polishing layer further includes at least one macro-channel; and

wherein the interfacial region aligns, through the thickness of the polishing pad, with the at least one macro-channel.

2. The polishing pad of claim 1, wherein the porous substrate is at least one of a film substrate having at least one of a plurality of holes and a plurality of through holes, a woven or nonwoven substrate and an open cell foam.

3. The polishing pad of claim 1, wherein the porous substrate does not include an open cell foam.

4. The polishing pad of claim 1, wherein the polishing layer further includes a plurality of inter-connected macro-channels.

5. The polishing pad of claim 4, wherein the interfacial region aligns, through the thickness of the polishing pad, with the plurality of inter-connected macro-channels.

6. The polishing pad of claim 1, wherein the porous substrate includes an edge seal compound that seals a least a portion of the circumference of the porous substrate.

7. The polishing pad of claim 6, wherein the edge seal compound seals at least about 70% of the circumference of the porous substrate.

8. The polishing pad of claim 1, wherein the polymer of the polishing layer comprises at least one of a thermoplastic and thermoplastic elastomer.

9. The polishing pad of claim 1, wherein the polishing layer includes a plurality of nanometer-size topographical features on at least one of the surface of the precisely shaped asperities, the surface of the precisely shaped pores and the surface of the land region.

10. The polishing pad of claim 1, wherein the working surface comprises a secondary surface layer and a bulk layer; and wherein at least one of the receding contact angle and advancing contact angle of the secondary surface layer is at least about 20° less than the corresponding receding contact angle or advancing contact angle of the bulk layer.

11. The polishing pad of claim 1, wherein the working surface comprises a secondary surface layer and a bulk layer; and wherein the receding contact angle of the working surface is less than about 50°.

12. The polishing pad of claim 1, wherein the thickness of at least a portion of the interfacial region is between about 10 microns and about 5 mm.

13. The polishing pad of claim 1, wherein the volume of the plurality of voids of the porous substrate is at least 100% of the volume of the portion of the polymer of the polishing layer that is embedded in the at least a portion of the plurality of voids of the porous substrate.

14. A polishing system comprising the polishing pad of claim 1 and a polishing solution.

15. A method of making a polishing pad comprising:

providing a polymer;

providing a porous substrate having a plurality of voids, the porous substrate being adjacent to the polymer;

embossing a surface of the polymer to form a polishing layer having a working surface, wherein the working surface includes a land region and at least one of a plurality of precisely shaped pores and a plurality of precisely shaped asperities; wherein the embossing forms an interfacial region having a portion of the polymer of the polishing layer embedded in the at least a portion of the plurality of voids of the porous substrate.

16. The method of making a polishing pad of claim 15, wherein the porous substrate is at least one of a film substrate having at least one of a plurality of holes and a plurality of through holes, a woven or nonwoven substrate and an open cell foam.

17. The method of making a polishing pad of claim 15, wherein the thickness of the land region is less than about 5 mm.