ABRASIVE ELEMENTS WITH PRECISELY SHAPED FEATURES, ABRASIVE ARTICLES FABRICATED THEREFROM AND METHODS OF MAKING THEREOF

Technical Field

[0001] The present disclosure relates generally to abrasives and abrasive articles.

Background

[0002] Various abrasive articles are described in, for example, U.S. Patent 9,956,664 and PCT Intl. Pubs. WO 2014/022462 and WO 2014/022465.

Summary

In one aspect, an abrasive article is provided. The abrasive article includes a plurality of abrasive features disposed on one or more abrasive elements. Each of the one or more abrasive elements includes a base having a first major surface from which the plurality of abrasive features extends. A first set of the plurality of abrasive features (i) has an average height, H_{1avg}, (ii) a standard deviation of less than 10% of H_{1avg}, (iii) comprises between 5 and 130 abrasive features, and (iv) has an areal density between 0.01 to 0.30 /cm^2.

In another aspect, a method of conditioning a polishing pad is provided. The method includes performing a CMP operation using a polishing pad and then contacting a working surface of the polishing pad with a working surface of the above-described abrasive article.

Brief Description of Drawings

[0003] FIG. 1A is a schematic top view of an abrasive article according to some embodiments of the present disclosure.

[0004] FIG. 1B is a schematic side view of the abrasive article of FIG. 1A.

[0005] FIG. 2A is a schematic top view of an abrasive article according to some embodiments of the present disclosure.

[0006] FIG. 2B is a schematic side view of the abrasive article of FIG. 2A.

[0007] FIG. 3A is a schematic top view of an abrasive element according to some embodiments of the present disclosure.

CLAIMS

1. An abrasive article comprising:

a plurality of abrasive features disposed on one or more abrasive elements, each of the one or more abrasive elements comprising a base having a first major surface from which the plurality of abrasive features extend;

wherein a first set of the plurality of abrasive features (i) has an average height, H_{1avg}, (ii) has a standard deviation of less than 10% of H_{1avg}, (iii) comprises between 5 and 130 abrasive features, and (iv) has an areal density between 0.01 to 0.30 /cm^2.

2. The abrasive article of claim 1, wherein a second set of the plurality of abrasive features has (i) an average height, H_{2avg}, and (ii) a standard deviation of less than 10% of H_{2avg}, wherein H_{1avg} is at least 5 microns greater than H_{2avg}.

3. The abrasive article of claim 2, wherein the second set of the plurality of abrasive features comprises at least 100 abrasive features.

4. The abrasive article of claim 2, wherein the cross sectional areas of each of the features of the second set of abrasive features (i) taken in a plane that is parallel to the first major surface of the bases, and (ii) at a position along the second set of abrasive features that is 50% or less of the H_{2avg}, cumulatively, is at least 5% of the cumulative projected areas of the of the one or more abrasive elements.

5. The abrasive article of claim 1, the features of the first set of abrasive features and their respective abrasive element bases, as a collective, are monolithic.

6. The abrasive article of claim 1, wherein the first set of abrasive features are precisely shaped features.

7. The abrasive article of claim 2, wherein the areal density of the second set of abrasive features is between 0.2 to 33.0 /cm^2.

8. The abrasive article of claim 1, wherein the abrasive elements comprise a carbide ceramic.

9. The abrasive article of claim 8, wherein carbide ceramic is silicon carbide, boron carbide, zirconium carbide, titanium carbide, tungsten carbide or combinations thereof.

10. The abrasive article of claim 1, wherein the abrasive elements are at least 99% by weight silicon carbide, based on the total weight of the base and the abrasive features.

11. The abrasive article of claim 1, wherein the porosity of the abrasive elements is less than 3%, wherein the porosity is the total volume of voids divided by the total volume of the body.

12. The abrasive article of claim 1, further comprising a chemical vapor deposited or physical vapor deposited coating disposed on the abrasive features.

13. The abrasive article of claim 1, further comprising a carrier plate having a first major surface; wherein the one or more abrasive elements are coupled to the first major surface of the carrier plate.

14. A method of conditioning a polishing pad, the method comprising:

performing a CMP operation using a polishing pad; and

contacting a working surface of the polishing pad with a working surface of the abrasive article of claim 1.