CLAIMS

What is claimed is:

1. A method of forming an instrumented cutting element, the method comprising:

forming a free standing sintered diamond table having at least one chamber in the free standing sintered diamond table;

providing an electrically conductive doped diamond material within the at least one chamber; and

attaching a substrate to the free standing sintered diamond table to form an instrumented cutting element including the doped diamond material disposed within the sintered diamond table on the substrate.

2. The method of claim 1, further comprising:

performing a first high temperature, high pressure sintering process to form a sintered diamond table on an initial substrate; and

removing the initial substrate to form the free standing sintered diamond table.

3. The method of claim 2, wherein removing the initial substrate comprises dissolving the initial substrate.

4. The method of claim 2, further comprising:

selecting the initial substrate to comprise at least one protrusion;

forming the sintered diamond table at least partially around the at least one protrusion; and

removing the at least one protrusion from within the diamond table to form the at least one chamber in the free standing sintered diamond table.

5. The method of claim1, further comprising removing a portion of the free standing sintered diamond table to form the at least one chamber in the free standing sintered diamond table.

6. The method of claim 5, wherein removing a portion of the free standing sintered diamond table comprises at least one of grinding, electric discharge machining, laser cutting, spark eroding, and applying a hot metal solvent to the free standing sintered diamond table.

7. The method of claim 1, further comprising:
providing at least one metal insert within the free standing diamond table; and
dissolving the at least one metal insert to form the at least one chamber within the free standing sintered diamond table.

8. The method of claim 1, wherein attaching a substrate to the sintered diamond table comprises subjecting the substrate and the free standing sintered diamond table to a high temperature, high pressure process.

9. The method of claim 8, further comprising forming at least one conduit in the instrumented cutting element, the at least one conduit coupled with the doped diamond material.

10. The method of claim 9, wherein forming the at least one conduit comprises forming the at least one conduit through the substrate.

11. The method of claim 10, wherein forming the at least one conduit further comprises forming the at least one conduit to extend through at least a portion of the sintered diamond table.

12. The method of claim 9, wherein forming the at least one conduit comprises forming the at least one conduit to extend across a face of the sintered diamond table.

13. A method of forming an earth-boring tool, the method comprising attaching at least one instrumented cutting element to a body of an earth-boring tool, the at least one instrumented cutting element having a diamond table bonded to a substrate, the diamond

table having at least one sensing element disposed at least partially within the diamond table, the at least one sensing element comprising a doped diamond material.

14. The method of claim 13, further comprising forming the at least one instrumented cutting element.

15. The method of claim 14, wherein forming the at least one instrumented cutting element comprises:

forming a free standing sintered diamond table having at least one chamber in the free standing sintered diamond table;

providing a doped diamond material within the at least one chamber to form the at least one sensing element; and

attaching a substrate to the free standing sintered diamond table to form the at least one instrumented cutting element including the doped diamond material disposed within the sintered diamond table on the substrate.

16. The method of claim 15, further comprising:

selecting an initial substrate to comprise at least one protrusion;

forming a sintered diamond table at least partially around the at least one protrusion; and

removing the at least one protrusion from within the diamond table to form the at least one chamber in the free standing sintered diamond table.

17. The method of claim 14, further comprising removing a portion of the free standing sintered diamond table to form the at least one chamber in the free standing sintered diamond table.

18. The method of claim 14, further comprising forming at least one conduit in the instrumented cutting element, the at least one conduit coupled with the doped diamond material.

19. The method of claim 18, further comprising disposing a dielectric material and a conductive element in the at least one conduit, the dielectric material electrically isolating the conductive element from the substrate.

20. The method of claim 13, further comprising leaching at least a portion of the diamond table proximate the at least one sensing element.

Claims

1. A method of forming an instrumented cutting element, the method comprising:

forming a free standing sintered diamond table by performing a first high temperature, high pressure (HTHP) sintering process, the free standing sintered diamond table having at least one chamber extending from a surface thereof only partially into the free standing sintered diamond table;

providing an electrically conductive doped diamond material within the at least one chamber after formation of the free standing sintered diamond table and performing a second HTHP sintering process;

attaching a substrate to the free standing sintered diamond table such that the electrically conductive doped diamond material in the at least one chamber is electrically coupled with a conductive material at an interface of the free standing sintered diamond table and the substrate.

2. The method of claim 1, wherein forming the free standing sintered diamond table by performing the first HTHP sintering process includes:

forming the sintered diamond table on an initial substrate; and

removing the initial substrate to form the free standing sintered diamond table.

3. The method of claim 2, wherein removing the initial substrate comprises dissolving the initial substrate.

4. The method of claim 2, further comprising:

selecting the initial substrate to comprise at least one protrusion;

forming the sintered diamond table at least partially around the at least one protrusion; and

removing the at least one protrusion from within the diamond table to form the at least one chamber in the free standing sintered diamond table.

5. The method of claim 1, further comprising removing a portion of the free standing sintered diamond table to form the at least one chamber in the free standing sintered diamond table.

6. The method of claim 5, wherein removing a portion of the free standing sintered diamond table comprises at least one of grinding, electric discharge machining, laser cutting, spark eroding, and applying a hot metal solvent to the free standing sintered diamond table.

7. The method of claim 1, further comprising:
providing at least one metal insert within the free standing diamond table; and
dissolving the at least one metal insert to form the at least one chamber within the free standing sintered diamond table.

8. The method of claim 1, wherein attaching the substrate to the sintered diamond table occurs while subjecting both the substrate and the free standing sintered diamond table with the electrically conductive doped diamond material within the at least one chamber to the second HTHP process.

9. The method of claim 8, further comprising forming at least one conduit in the substrate of the instrumented cutting element, the at least one conduit coupled with the doped diamond material within the at least one chamber of the sintered diamond table.

10. The method of claim 9, wherein forming the at least one conduit further comprises forming the at least one conduit to extend through at least a portion of the sintered diamond table.

11. The method of claim 10, wherein forming the at least one conduit comprises forming the at least one conduit to extend to the doped diamond material within the at least one chamber located at a face of the sintered diamond table.

12. A method of forming an earth-boring tool, the method comprising:

forming at least one instrumented cutting element by:

performing a first high temperature, high pressure (HTHP) sintering process to form a free standing sintered diamond table having at least one chamber at least substantially entirely enclosed by the free standing sintered diamond table;

providing a doped diamond material within the at least one chamber after formation of the free standing sintered diamond table to form at least one sensing element;

performing a second HTHP sintering process on the doped diamond material and the sintered diamond table; and

attaching a substrate to the free standing sintered diamond table with the doped diamond material within the at least one chamber to form the at least one instrumented cutting element such that the doped diamond material is at least substantially entirely embedded within the sintered diamond table on the substrate; and

attaching at least one instrumented cutting element to a body of an earth-boring tool.

13. The method of claim 12, wherein forming the at least one free standing sintered diamond table includes:

selecting an initial substrate to comprise at least one protrusion;

forming a sintered diamond table at least partially around the at least one protrusion; and

removing the at least one protrusion from within the diamond table to form the at least one chamber in the free standing sintered diamond table.

14. The method of claim 12, further comprising removing a portion of the free standing sintered diamond table to form the at least one chamber in the free standing sintered diamond table.

15. The method of claim 12, further comprising forming at least one conduit in the substrate of the instrumented cutting element, the at least one conduit coupled with the doped diamond material.

16. The method of claim 15, further comprising disposing a dielectric material and a conductive element in the at least one conduit, the dielectric material electrically isolating the conductive element from the substrate.

17. The method of claim 12, further comprising leaching at least a portion of the diamond table proximate the at least one sensing element.

18. The method of claim 1, further comprising disposing a dielectric material within the at least one chamber within the diamond table such that the dielectric material is between the doped diamond material and the diamond table after the doped diamond material is provided within the at least one chamber.

19. The method of claim 1, further comprising removing a metal solvent catalyst material from within interstitial spaces between inter-bonded diamond grains of the diamond table.

20. The method of claim 12, wherein attaching the substrate to the free standing sintered diamond table with the doped diamond material within the at least one chamber occurs while from performing the second HTHP sintering process on the doped diamond material and the sintered diamond table.