CLAIMS

1. A lead-based alloy comprising, in percent by total alloy weight:
   0.0090% to 0.0600% bismuth;
   0.0075% to 0.0125% antimony;
   0.0075% to 0.0125% arsenic;
   0.0035% to 0.0060% tin; and
   up to 0.0100% silver;
   up to 0.0010% thallium; and
balance lead and incidental impurities.

2. The lead-based alloy of claim 1, wherein the alloy contains from 0.0001% to 0.0010% thallium.

3. The lead-based alloy of claim 1, wherein the alloy contains up to 0.0005% thallium.

4. The lead-based alloy of claim 3, wherein the alloy contains from 0.0001% to 0.0005% thallium.

5. The lead-based alloy of claim 1, wherein the alloy contains less than 0.0010% (10 ppm), in total by weight, of tellurium, selenium, nickel, copper, molybdenum, manganese, cobalt, and chromium.

6. The lead-based alloy of claim 1, wherein the alloy contains less than 0.0001% (1 ppm), individually by weight, of tellurium, selenium, nickel, copper, molybdenum, manganese, cobalt, and chromium.

7. The lead-based alloy of claim 1, wherein the alloy contains 0.0090% to 0.0150% bismuth.

8. The lead-based alloy of claim 1, wherein the alloy contains 0.0090% to 0.0110% antimony.

9. The lead-based alloy of claim 1, wherein the alloy contains 0.0090% to 0.0110% arsenic.

10. The lead-based alloy of claim 1, wherein the alloy comprises:
0.0090% to 0.0150% bismuth;
0.0090% to 0.0110% antimony;
0.0090% to 0.0110% arsenic;
0.0035% to 0.0060% tin;
up to 0.0100% silver;
up to 0.0010% thallium; and
balance lead and incidental impurities.

11. A process for the production of doped leady oxide comprising:
charging lead-based alloy ingots into a ball mill, wherein the lead-based alloy ingots comprise the lead-based alloy of claim 1;
milling the lead-based alloy ingots in air;
oxidizing the lead-based alloy during the milling to form doped leady oxide; and
forming powder particles of the doped leady oxide during the milling.

12. A process for the production of doped leady oxide comprising:
melting the lead-based alloy of claim 1;
atomizing the molten lead-based alloy to form molten lead-based alloy droplets;
oxidizing the atomized molten lead-based alloy droplets; and
solidifying the oxidized lead-based alloy droplets to form a doped leady oxide powder.

13. A doped leady oxide powder comprising an oxidation product of the lead-based alloy of claim 1.

14. A process for the production of a lead-acid battery electrode comprising:
mixing water and the doped leady oxide powder of claim 13 to produce an intermediate paste;
mixing aqueous sulfuric acid with the intermediate paste to produce an active material precursor paste;
applying the active material precursor paste to a lead-based alloy grid to produce a plate; and
exposing the plate to controlled temperature and relative humidity conditions for a period of time to cure the paste on the lead-based alloy grid and produce a cured plate.

15. The process of claim 14, further comprising mixing the water with the doped leady oxide powder of claim 13 and at least one additive selected from the group consisting of a lignosulfonate, barium sulfate, ammonium sulfate, magnesium sulfate, tetrabasic lead sulfate, tribasic lead sulfate, and carbon.

16. The process of claim 14, further comprising passing an electrical current through the cured plate to electrochemically convert the cured paste into an active material comprising doped lead dioxide or spongy lead alloy, thereby forming the lead-acid battery electrode.

17. A lead-acid battery electrode comprising:
a lead-based alloy grid; and
an active material located on the lead-based alloy grid, wherein the active material is formed from the doped leady oxide powder of claim 13.

18. A process for the production of a lead-acid battery comprising:
electrically interconnecting a plurality of electrodes to produce a cell, wherein the electrodes comprise an active material formed from the doped leady oxide powder of claim 13;
assembling at least one cell inside a casing;
adding an aqueous sulfuric acid electrolyte into the casing and in contact with the plurality of electrodes; and
sealing the casing.

19. A lead-acid battery comprising an electrode comprising an active material formed from the doped leady oxide powder of claim 13.