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13. The method of claim 12, wherein the electrode comprises lithium.

14. The method of claim 12, wherein the electrode comprises carbon.

15. A method for improving surface smoothness during electrodeposition of lithium on a substrate surface, the method comprising:

providing an electrolyte solution comprising lithium cations and a soluble, surface-smoothing additive comprising cations of a second conductive material (C2) selected from a group consisting of cesium, rubidium, potassium, strontium, barium, calcium, and combinations thereof, wherein cations of C2 have an activity in solution such that an effective electrochemical reduction potential of the cations of C2 is lower than an electrochemical reduction potential of the lithium cations;

applying an electrical potential that is less than the electrochemical reduction potential of the lithium cations and greater than the effective electrochemical reduction

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potential of the cations of C2, thereby reducing the lithium cations and forming lithium on the substrate surface;

accumulation cations of C2 at protrusions on the substrate surface, thereby forming an electrostatically shielded region near each protrusion; and

temporarily repelling the lithium cations from the electrostatically shielded region near each protrusion.

16. The method of claim 15, wherein the cations of C2 have a concentration in the electrolyte solution that is less than 10% of that of the lithium cations.

17. The method of claim 15, wherein the cations of C2 have a concentration in the electrolyte solution that is less than, or equal to, 5% of that of the lithium cations.

18. The method of claim 15, wherein the surface-smoothing additive comprises an anion comprising PF_6^- anion.

19. The method of claim 15, wherein the substrate is a battery anode comprising lithium or a battery anode comprising carbon.

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