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Water Based Microdroplet Spray for On Demand Lithium Metal Films and Nanoparticles

Water based microdroplet spray that directly writes lithium metal and Li_3N coatings—simplifying battery electrode prep and catalyst fabrication.

Battery makers and advanced materials teams struggle to deposit lithium metal or lithium nitride on substrates without costly dry room infrastructure, vacuum systems, or pyrophoric handling—slowing scale up and raising scrap and safety risk. This technology uses a water containing microdroplet spray to deposit lithium salt microdroplets onto a surface. Compared to vacuum evaporation or anhydrous electroplating, the approach is expected to lower capital and operating cost, simplify EH&S controls, enable direct write patterning, and tune morphology (nanoparticles, films, or dendrites) for performance and throughput. Current evidence comes from benchtop electrospray deposition with TEM/EELS/EDS confirming metallic Li and Li_3N in the deposits under ambient conditions. If proven at tool scale, manufacturers could speed electrode prelithiation, create protective interlayers for solid state cells, and produce catalyst grade Li materials with fewer steps and less specialized infrastructure.

Technology Validation:

In benchtop electrospray deposition under ambient conditions, substrates coated from aqueous lithium salt sprays produced Li and N containing nanoparticles; TEM/EDS mapped composition, and EELS resolved the Li K edge consistent with metallic lithium, with additional features consistent with Li halides/oxides. Adjusting spray potential shifted morphology from ~8–9 nm spheroidal particles to dendritic structures; Li_3N signatures were associated with the smaller nanoparticle fraction.

Advantages:

- Ambient, water based processing: avoids vacuum and ultra dry anhydrous lines typical of lithium handling (expected cost and EH&S simplification).

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Category
Energy & Power Systems/Energy Storage
Materials Science & Nanotechnology/Advanced Functional Materials
Chemicals & Advanced Materials/Materials Processing & Manufacturing Technologies

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- Direct write & patternable deposition: steered spray enables films, features, or coatings on conducting or non conducting substrates.

- Tunable morphology: process conditions yield nanoparticles, continuous films, or dendrites to optimize surface area vs. density.

- Integration ready: conceptually compatible with inline or roll to roll spray tools for electrode or catalyst coating.

- Feedstock flexibility: uses commodity lithium salts rather than molten metal or organolithium reagents.

Applications:

- Anode prelithiation for next gen Li ion and solid state cells (coating current collectors or pre forming interlayers).

- Protective/interfacial lithium layers in solid state batteries to improve interfacial contact (lab scale pathway indicated).

- Patterned lithium features for microbatteries and thin film cells where direct write simplifies fabrication.

- Catalyst grade Li/Li_3N nanoparticles for ammonia synthesis or other Li mediated chemistries (early evidence aligns with Li_3N formation).

TRL: 3

Intellectual Property:

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