



## Lithium Dendrites VS Sodium Dendrites



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Characteristic	Lithium Dendrites	Sodium Dendrites	Difference Explanation & Impact
Physical Properties	Small atomic weight (6.94), small ionic radius (0.076 nm)	Large atomic weight (22.99), large ionic radius (0.102 nm)	Sodium ions are larger and heavier, resulting in slower diffusion and migration speeds in electrolytes and different deposition kinetics.
Mechanical Properties	High hardness, high strength (Young's modulus ~4.9 GPa), tough and sharp dendrites.	Softer, more brittle (Young's modulus ~2.5 GPa), dendrites are more prone to bending and breaking.	This is one of the most critical safety differences. Hard lithium dendrites act like "needles" that easily pierce separators; softer sodium dendrites resemble "moss" or "branches," exerting relatively weaker mechanical force to penetrate separators.
Electrochemical Behavior	Relatively low Coulombic efficiency during deposition/dissolution, more severe side reactions with electrolytes, leading to unstable, porous solid electrolyte interphase (SEI) films.	Relatively higher Coulombic efficiency during deposition/dissolution, slightly lower reactivity with common electrolytes, potentially forming more stable and uniform SEI films.	Sodium has higher theoretical capacity and a lower reduction potential, but its interfacial chemistry with electrolytes is relatively milder, contributing to more uniform deposition.
Deposition Morphology	Prone to forming elongated, sharp needle-like or dendritic structures.	Tends to form coarser, porous, moss-like, or spherical deposits, and under specific conditions, even flat, dendrite-free deposition is possible.	Sodium dendrite growth patterns are likely more "blunt," making it less prone to forming sharp local protrusions, thereby reducing the risk of internal short circuits.
Thermodynamic Properties	High melting point (180.5°C), high heat of reaction.	Low melting point (97.8°C), relatively lower heat of reaction.	In thermal runaway scenarios, sodium metal will melt first, potentially alleviating dendrite penetration through a "self-healing" mechanism. Lithium, once in a thermal runaway, react violently with extremely high Temperatures.