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Acoustic Field Patterning of Battery Electrodes

Application of acoustic fields while making a battery electrode can rapidly transform a random slurry of battery materials into organized structures, regardless of what those exact materials may be. This change boosts both how much energy the battery can store and how fast it can charge, sidestepping a fundamental tradeoff in conventional battery manufacturing.

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What is the Problem?

In conventional battery manufacturing, there is a built-in tradeoff between the energy an electrode can hold and the power it can deliver. A thicker electrode can contain more active material to hold energy, but this results in a longer path the lithium must travel during charging or discharging, significantly hindering high power performance. This fundamental tradeoff is due to the random distribution of active material in conventional manufacturing processes.

To decouple power and energy, active material can instead be patterned into a 3-dimensional structure. 3D-structured electrodes have previously been shown to increase both power and energy by over 10%. However, the current methods used to research these electrodes are not scalable due to slow speeds, material-specific requirements, or quality issues.

What is the Solution?

Technology ID

BDP 8787

Category

Selection of Available Technologies
Cleantech/Energy Storage/Batteries

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The technology uses acoustic waves to rapidly organize the active material in an electrode, from a random structure to regular patterns. The acoustic waves can be varied for different spacings or combined with other acoustic waves for two dimensional patterns. As a result of this structure in place of randomness, the difficulty lithium faces moving through the material is greatly reduced. A battery built on such a technology would be able to both provide more power, while carrying more energy.

What is the Competitive Advantage?

In other approaches to 3D-structuring, drawbacks have included high costs, long processing times and specific requirements on what battery materials can be used. Acoustic patterning, on the other hand, happens in seconds regardless of what the material is made out of. The relative ease of applying an acoustic field coupled with the short processing time and lack of material requirements makes this process significantly more scalable than its competitors.

A battery built on this technology could reap the benefits of 3D-structuring without the typical costs of other methods. Unlike today's batteries relying on conventional manufacturing, the energy storage and power delivery capability can both be improved instead of being inversely linked.

References

1. Emilee Nicole Armstrong, Keith Edward Johnson, Matthew R Begley, Corie Lynn Cobb(2021) , https://iopscience.iop.org/article/10.1149/MA2021-024470mtgabs, https://iopscience.iop.org/journal/2151-2043, 2, 470
2. Corie Lynn Cobb, Matthew R Begley, Emilee Nicole Armstrong, Keith Edward Johnson(2022) , https://iopscience.iop.org/article/10.1149/MA2022-026608mtgabs, https://iopscience.iop.org/journal/2151-2043, 2, 608
3. Keith E. Johnson, Drew S. Melchert, Emilee N. Armstrong, Daniel S. Gianola, Corie L. Cobb, Matthew R. Begley(2023-08) , https://doi.org/10.1016/j.matdes.2023.112165, https://www.sciencedirect.com/journal/materials-and-design, 232, 112165
4. Keith E. Johnson, Brandon C. Montano, Kailino J. Nambu, Emilee N. Armstrong, Corie L. Cobb, Matthew R. Begley(45183) , https://doi.org/10.1016/j.matdes.2023.112328, https://www.sciencedirect.com/journal/materials-and-design, 234, 112328
5. Keith E Johnson, Brandon C Montano, Kailino J Nambu, Emilee N Armstrong, Matthew R Begley(2023-08) , https://doi.org/10.1016/j.matdes.2023.112328, https://www.sciencedirect.com/journal/materials-and-design, 234, 112328