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# Challenges of Transitioning to Solid-State Batteries

## Description

Automakers globally are facing an impending "EV winter," marked by reduced demand for electric vehicles (EVs). However, the development of solid-state batteries, which are approaching readiness for production, represents a positive advancement in the sector. Unlike conventional EV batteries, which rely on liquid electrolytes, solid-state batteries utilise a solid electrolyte. This change helps improve safety by eliminating flammable materials.

Despite their potential benefits, solid-state batteries encounter significant challenges. Engineers are focused on lowering manufacturing costs, efficiently managing battery temperatures, optimising ion flow, and preventing short circuits caused by lithium. Current industry practices suggest that solid-state batteries may require significantly more lithium than their traditional counterparts—between five to ten times more—due to their design.

This increased demand for lithium could exacerbate market prices, which are already sensitive to fluctuations in mining practices. In the United States, the recent removal of the federal tax credit for EVs has caused a decline in sales, although the overall market still shows promising growth internationally, particularly in China and Europe.

Another major concern involves dendrite formation, a tendency of lithium to develop spiky structures that can bridge the separator between battery electrodes. This poses risks, including short circuits and potential fire hazards due to thermal runaway. While dendrites can occur with other battery chemistries, such as sodium-ion, research is progressing to mitigate this issue.

Production costs for solid-state batteries also remain high. Ensuring that the three-layer design—anode, electrolyte, and cathode—is in close contact is complex. Moreover, the use of ceramic materials for separators adds to production difficulties due to their fragility.

In summary, thermal management is crucial for solid-state batteries, as temperature fluctuations can disrupt battery performance. Companies are navigating these obstacles as they strive to refine the technology and enhance the viability of solid-state batteries in the evolving EV landscape.

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## Vocabulary List:

1. **Impending** /ɪmˈpɛn.dɪŋ/ (adjective): About to happen; imminent.
2. **Conventional** /kənˈvɛn.ʃən.əl/ (adjective): Based on or in accordance with what is generally done or believed.
3. **Exacerbate** /ɪgˈzæs.ər.beɪt/ (verb): To make a problem bad situation or negative feeling worse.
4. **Dendrite** /ˈdɛn.draɪt/ (noun): A branching structure of a neuron or in this context a structure formed by lithium in batteries.
5. **Thermal** /ˈθɜr.məl/ (adjective): Related to heat.



6. **Fragility** /frə'dʒɪl.ɪ.ti/ (noun): The quality of being easily broken or damaged.

## Comprehension Questions

### Multiple Choice

1. What is one positive advancement represented by the development of solid-state batteries?

- Option: Lower manufacturing costs
- Option: Increased reliance on liquid electrolytes
- Option: Improved safety by eliminating flammable materials
- Option: Reduced demand for electric vehicles

2. Why do solid-state batteries encounter significant challenges according to the text?

- Option: High demand for lithium
- Option: Low manufacturing costs
- Option: Efficient ion flow optimization
- Option: Use of liquid electrolytes

3. What is a major concern related to solid-state batteries discussed in the text?

- Option: Efficient ion flow optimization
- Option: Use of ceramic materials for separators
- Option: Dendrite formation
- Option: Reduced lithium demand

4. What is highlighted as crucial for solid-state batteries in terms of temperature management?

- Option: Decreasing lithium demand
- Option: Optimizing ion flow
- Option: Thermal management
- Option: Ceramic material fragility

5. How are solid-state batteries different from conventional EV batteries?

- Option: Use liquid electrolytes
- Option: Have higher manufacturing costs
- Option: Utilize solid electrolytes
- Option: Contain flammable materials

6. What is a challenge in solid-state battery production as mentioned in the text?



- Option: Fragility of ceramic materials
- Option: Low lithium demand
- Option: Efficient ion flow optimization
- Option: Reduced thermal issues

### True-False

7. Solid-state batteries use liquid electrolytes.
8. The recent removal of the federal tax credit for EVs in the US has increased sales.
9. Dendrite formation in solid-state batteries poses risks such as short circuits and fire hazards.
10. Solid-state batteries have low production costs compared to conventional batteries.
11. Solid-state batteries require less lithium than traditional batteries.
12. Ensuring close contact between the anode, electrolyte, and cathode is a complex aspect of solid-state battery production.

### Gap-Fill

13. Solid-state batteries may require significantly more lithium than traditional batteries, between five to ten times more, due to their \_\_\_\_\_.
14. The removal of the federal tax credit for EVs in the US has caused a decline in sales, although the overall market still shows promising growth internationally, particularly in China and \_\_\_\_\_.
15. Another major concern with solid-state batteries involves dendrite formation, a tendency of lithium to develop spiky structures that can bridge the separator between battery electrodes, posing risks such as \_\_\_\_\_ and potential fire hazards.
16. Solid-state batteries have challenges including high production costs and the complexity of ensuring



that the three-layer design—anode, electrolyte, and cathode—is in close \_\_\_\_\_ .

17. Thermal management is crucial for solid-state batteries, as temperature fluctuations can disrupt battery \_\_\_\_\_ .

18. Companies are striving to enhance the viability of solid-state batteries by refining the technology to navigate obstacles such as high production costs and fragility of ceramic \_\_\_\_\_ .

## Answer

**Multiple Choice:** 1. Improved safety by eliminating flammable materials 2. High demand for lithium 3. Dendrite formation 4. Thermal management 5. Utilize solid electrolytes 6. Fragility of ceramic materials

**True-False:** 7. False 8. False 9. True 10. False 11. False 12. True

**Gap-Fill:** 13. design 14. Europe 15. short circuits 16. contact 17. performance 18. materials

## Answer

### CATEGORY

1. Business - LEVEL6

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