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Institute for Energy Materials and Devices (IMD)
Materials Synthesis and Processing (IMD-2)

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Novel Low-Temperature Process for High-Efficiency Solid-State Battery Materials and Components

Technology Description

This technology introduces an innovative process for manufacturing materials and components used in solid-state batteries, particularly those involving NaSICON (Sodium Super Ionic Conductor) materials. The process involves heating a starting material along with sodium and H3BO3 additives at temperatures between 600°C and 1300°C. This method enables the production of key battery materials and components at significantly lower temperatures than traditional methods, offering a cost-effective and energy-efficient approach.

Problem

Traditional manufacturing processes for solid-state battery materials, especially NaSICON, require high temperatures, often exceeding 1000°C, which leads to high energy consumption, prolonged production times, and increased costs. These methods typically involve multiple calcination steps and intermediate milling, further complicating the manufacturing process and making it less efficient.

Solution

This new technology significantly reduces the required production temperature, allowing the creation of NaSICON materials and other solid-state battery components at temperatures as low as 850°C. By using sodium sources and H3BO3 as additives, the process eliminates the need for multiple calcination steps and intermediate milling, resulting in a more efficient, cost-effective, and simpler production process while maintaining the desired material properties like density and ionic conductivity.

Potential Use

The technology is ideal for manufacturing various components of solid-state sodium batteries, including electrodes and separators. These components are crucial for creating energy-efficient and cost-effective batteries, which can be used in a wide range of applications, from electric vehicles to large-scale energy storage systems. The ability to produce these components more efficiently opens up new possibilities for developing advanced, high-performance batteries at a lower cost.

Interesting for the following sectors
» Automotive Industrie
» Energy Storage

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Keywords
- Solid-State Battery
- NaSICON Material
- Sodium-Ion Conductivity
- Liquid-Phase Sintering
- Reduced Sintering Temperature
- Solid Electrolyte
- Sodium Borate Additive

More Information
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This technology which involves a method for producing materials or components for solid-state batteries, is highly relevant to several sectors:

1. **Automotive Industry**: Solid-state batteries are considered the next generation of energy storage for electric vehicles (EVs) due to their potential for higher energy density, longer life, and improved safety compared to traditional lithium-ion batteries. This technology can significantly impact the production and performance of EV batteries.
2. **Energy Storage**: Solid-state batteries are ideal for grid storage applications, offering safer and more durable energy storage solutions. The technology could enhance the efficiency and cost-effectiveness of renewable energy storage systems.
3. **Consumer Electronics**: As devices become more power-hungry, the demand for longer-lasting and safer batteries increases. This method could be applied to create more efficient batteries for smartphones, laptops, and other portable electronics.
4. **Aerospace**: High-performance batteries with better safety profiles are crucial for aerospace applications. This technology could lead to the development of more reliable power sources for satellites and other high-tech equipment.
5. **Medical Devices**: Solid-state batteries can offer safer and longer-lasting power sources for implantable medical devices, wearables, and other critical healthcare equipment.

This method's ability to produce materials at lower temperatures and with improved characteristics like ionic conductivity and crystal structure is a significant advancement that could reduce production costs and enhance battery performance across these sectors.

Development Status and Next Steps

Forschungszentrum Jülich has extensive expertise in this field and holds several patents. The Institute for Energy Materials and Devices - Materials Synthesis and Processing (IMD-2) is continuously seeking for cooperation partners and/or licensees in this and adjacent areas of research and applications.

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