International Advanced Research Centre for Powder Metallurgy & New Materials (ARCI)

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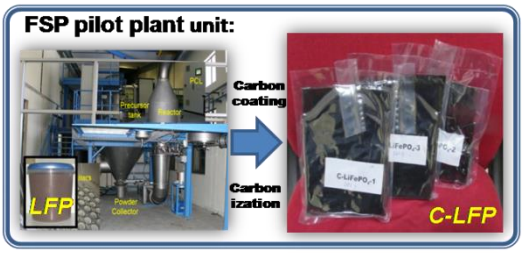
Development of High Performance Carbon coated $LiFePO_4$ by a Cost-effective and Scalable Process

Overview

Lithium ion batteries play an important role in the field of electric vehicle (EV) industries due to their high energy density and power density in comparison to other secondary batteries. Though there exists a great demand for large quantities of electrode materials for EV application, many research groups focus on basic (lab scale R&D) research rather than large scale production of electrode materials. In contrast, ARCI focuses mainly on development of nano-structured electrode materials in large scale by cost-effective processes. Among cathode materials, $LiFePO_4$ becomes promising for electric vehicle batteries due to their high energy density, structural and thermal stability. ARCI successfully synthesized carbon coated $LiFePO_4$ by a large scale flame spray pyrolysis process followed by carbon coating and the electrochemical performance of the resulting material is on par with commercial C-LFP. Prismatic cells having a capacity of 2.8 Ah and a potential of 3.2 V were fabricated and four such cells were connected in series to get a potential of 12 V for the demonstration of 12 V DC motor fan.

Key Features

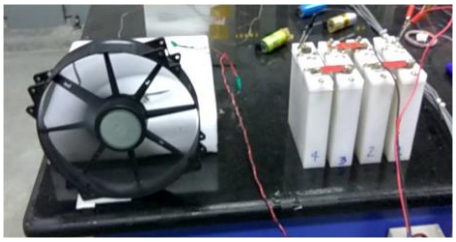
- Methods which can produce 1-2kg of nano-powders were used for large scale production of carbon coated $LiFePO_4$ (C-LFP)material.
- The method was found to be economical and simple.
- Has the potential to fine tune the properties of cathode produced.
- Electrochemical performance of C-LFP produced found to be on par with commercial C-LFP and the method is scalable.
- Prototype LIB cells fabrication & demonstration using indigenous C-LFP material.



Large scale synthesized carbon coated $LiFePO_4$ (C-LFP)

Potential Applications

- High energy density cathode for electric vehicles
- High power density cathode for marine application
- Other portable devices where LIB s are used.



Benchmark studies of $LiFePO_4$ and $Li_4Ti_5O_{12}$ with commercial cathode and anode at 1C

Technology Readiness Level (TRL): 5

- Performance and stability are validated at laboratory scale
- Scale-up has been carried out successfully
- Prototype testing is under process using pilot plant facility.

IPDI*	1	2	3	4	5	6	7	8	9	10
Activities	*Basic concepts and understanding of underlying scientific principles*	*Short listing possible applications*	*Research to prove technical feasibility for targeted application*	*Coupon level testing in stimulated conditions*	*Check repeatability/ consistency at coupon level*	*Prototype testing in real-life conditions*	*Check repeatability/ consistency at prototype level*	*Reassessing feasibility (IP, competition technology, commercial)*	*Initiate technology transfer*	*Support in stabilizing production*
Status	**60 %**									

Major Patents / Publications

1. Development of a novel carbon-coating strategy for producing core-shell structured carbon coated $LiFePO_4$ for improved Li-ion battery performance- ***Phys Chem Chem Phys*** 19, 175-188, **2017**.

2. "Investigation of *in-situ* carbon coated $LiFePO_4$ as a superior cathode materials for Lithium ion batteries", ***Journal of Nanoscience and Technology,*** 19, 3002, **2019**.

Centre For Nano materials

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