Dry Electrode Process Technology

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Within this decade, there has been immense effort focused on reducing the cost of energy storage devices. The goal towards energy independence through electrification of automobiles for widespread adoption has greatly incentivized this endeavor. Strategies ranging from novel materials investigation to advanced device manufacturing development span the cost reduction effort. Maxwell Technologies is actively engaged in this global effort from the direction of dry electrode fabrication technology. Maxwell dry electrode technology offers manufacturing cost and performance competitiveness, and novel battery chemistry enablement. This paper provides the initial foundation and validation for the application of dry coated electrode in lithium-ion batteries.

Maxwell Technologies is a San Diego based ultracapacitor manufacturer that uses a proprietary liquid-free electrode production process. Advanced process development without the need for solvents has enabled Maxwell's dry electrode production lines to operate at high throughput using a minimal manufacturing footprint. This unique electrode manufacturing process does not introduce any volatile waste products into the atmosphere or require complex manufacturing plant arrangement. It begins with dry raw materials compounding and maintains its liquid-free state throughout the subsequent processing steps to ultimately produce a robust high-performance ultracapacitor electrode. Since this process produces a dry active material free-standing film, the scrap is collected and reused in the successive processing batches.

Maxwell is currently engaged in research and development efforts to expand the application space of its dry electrode process technology to include battery electrode manufacturing. Cell performance using prototype dry coated lithium-ion battery electrodes has been demonstrated under two DOE funded programs. Electrode configuration with various architectures using a wide range of materials can be produced at thicknesses ranging from about 50 microns to about 1 millimeter. In addition to manufacturing flexibility, the cohesion and adhesion properties of electrodes derived from the dry process are superior in the presence of electrolyte at high temperatures compared to those produced using the wet coating technology.

This unique electrode process technology offers significant saving in manufacturing cost and helps curb CO_2 pollution during the battery electrode manufacturing process. By eliminating the use of any liquids/solvents, and the associated coating and drying complexity inherent in wet processing, the dry electrode process is environmentally friendly, and can be readily installed and commissioned with a much lower start-up capital investment. Thus, dry electrode manufacturing is economically attractive and socially responsible.

This paper will provide insight into dry electrode coating technology and its capacity for the enablement of advanced battery chemistries, and cell performance results derived from dry coated lithium-ion battery electrodes.