SILICON ANODE APPLICATION

Coretec Cyclohexasilane

Coretec Cyclohexasilane (CHS) is a liquid at room temperature, providing manufacturing advantages in processing the silicon and silicon/carbon nanostructures needed in today's silicon anodes as a direct replacement for graphite in high energy lithium ion battery anodes. A key benefit is the potential for superior charge-discharge cycle lifetime and increased energy density.

Feature	Benefit
Process as liquid or gas	Lower cost and more facile processing yielding silicon nanowires with solution chemistries
Ease of manufacture	CHS can readily yield silicon nanostructures in solution, be used to make Si/C composites in a single pot, and be implemented into existing PECVD/CVD/ALD processes
Long shelf life	Two year shelf life when stored at room temperature
Liquid transport and storage	Lower storage and transportation costs compared to gas

THE CHALLENGE:

Lithium-ion batteries are a dominant source of energy storage for portable applications ranging from mobile devices to electric car batteries. After years of advances in energy cycle lifetime, cost, and performance, continued market growth remains dependent on further improvements in energy density, while maintaining cost and cycle lifetime.

THE POSSIBILITY:

Coretec Cyclohexasilane's unique liquid state enables a new type of silicon anode fabrication and by replacing the graphite anode commonly used in lithium-ion batteries with pure silicon, silicon-carbon nanocomposites, or alloys, a dramatic increase in energy density can be achieved. Silicon based materials store more lithium ions, and when nanostructured reduce the potential for damage due to decreased silicon expansion. CHS has been successfully used to create silicon thin films and silicon-carbon nanocomposites including carbon coated silicon nanowires and core shell nanostructures. CHS also presents an opportunity for highly doped silicon materials and silicon alloys with B, P and Ge, respectively.

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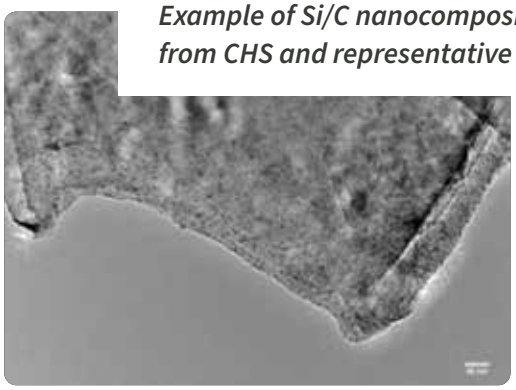
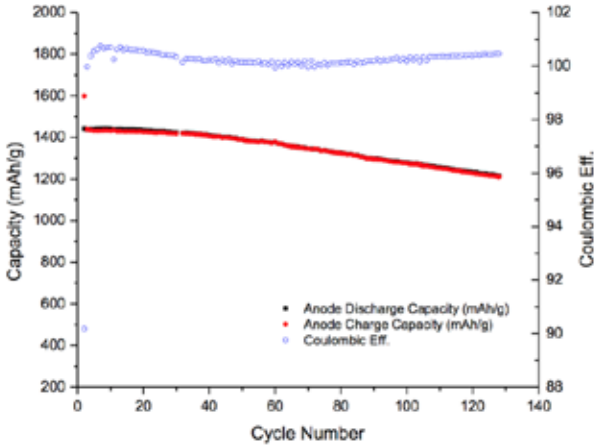
WHAT DOES THIS MEAN?

The increased energy density of the anode enables greater capacity from the same battery size and weight. When optimized with the cathode and electrolyte, silicon anodes used in lithium-ion batteries have an increased potential for fast charging, extended range, and longer cycle life.

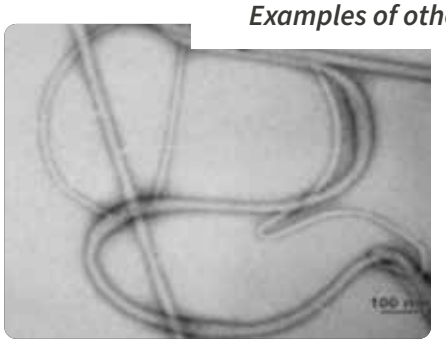
Example of Si/C nanocomposite derived from CHS and representative cycling data.



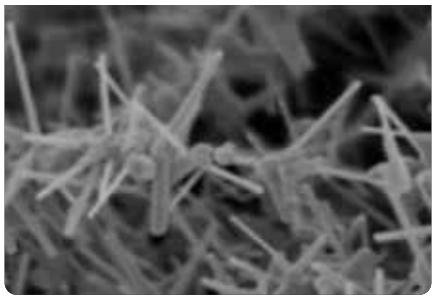
Si/C nanocomposite



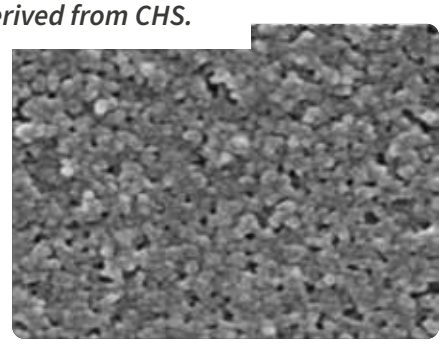
Examples of other nanostructured silicon materials derived from CHS.



Si nanowires



Si coated carbon nanotubes



Si thin films

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