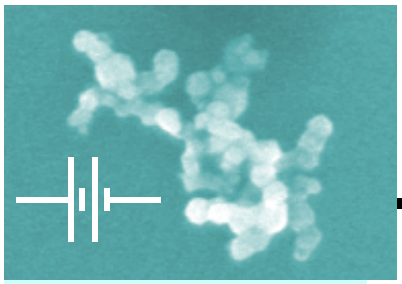

Lithium Ion Battery

Nanomaterials

...a plus for batteries

Customer Solutions

nGimat offers its customers product sales, license arrangements, and R&D services.

Development and sale of components and advanced nano-materials

Research and development services for emerging technologies

Licensing under strategic alliances and joint ventures of CCVD process and advanced material technology

Sale of CCVD coating equipment in association with customer licensees

Please visit us at www.ngimat.com or contact us directly for details or more information about customer solutions at *n*Gimat.

nGimat™ Co.

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*nano*Engineered Materials™

*n*Gimat™ Nanopowders

*n*Gimat's nanopowders and composites make high-performance, low-cost materials for lithium ion batteries. Lithium ion negative electrode nanopowders, including lithium titanium oxide spinels and tin oxide solid electrolyte composites, are prepared using our proprietary Combustion Chemical Vapor Condensation (CCVC) process enabled by the Nanospray℠ Combustion Processing technology. Lithium nickel oxide based layered compound nanomaterials (popular high capacity positive electrodes in lithium test cells) also have been prepared. The table below summarizes our materials capabilities and highlights performance advantages achieved to date. Note the superior performance of our SnO materials compared to that of micron-size SnO obtained commercially. Additionally, our continuous thin films of SnO_x-solid electrolyte composites exhibit unprecedented rate performance at 100 mA/g Sn.

Lithium Ion Materials Prepared by CCVC Process

Material	Particle size (nm)	Comments
$SnO\text{-}LiTi_2(PO_4)_3$	10-15	260 mAh/g@ 100mA/g Sn at -10°C
SnO	10-20	278 mAh/g@ 100mA/g Sn at -10°C
SnO (Strem)	*1800*	*<0.1 mAh/g at -10°C*
$SnO\text{-}LiTi_2(PO_4)_3$ thin film composite	Thickness: 0.5-1 um	598 mAh/g @ 100mA/g Sn at 25°C
$Li_4Ti_5O_{12}$	15-30	110 mAh/g @5C rate
$LiCo_xNi_{1-x}O_2$	50-70	Layered phase; improved cycle life
$LiNi_xMn_{2-x}O_4$	35-50	5V material; spinel phase

Market Potential

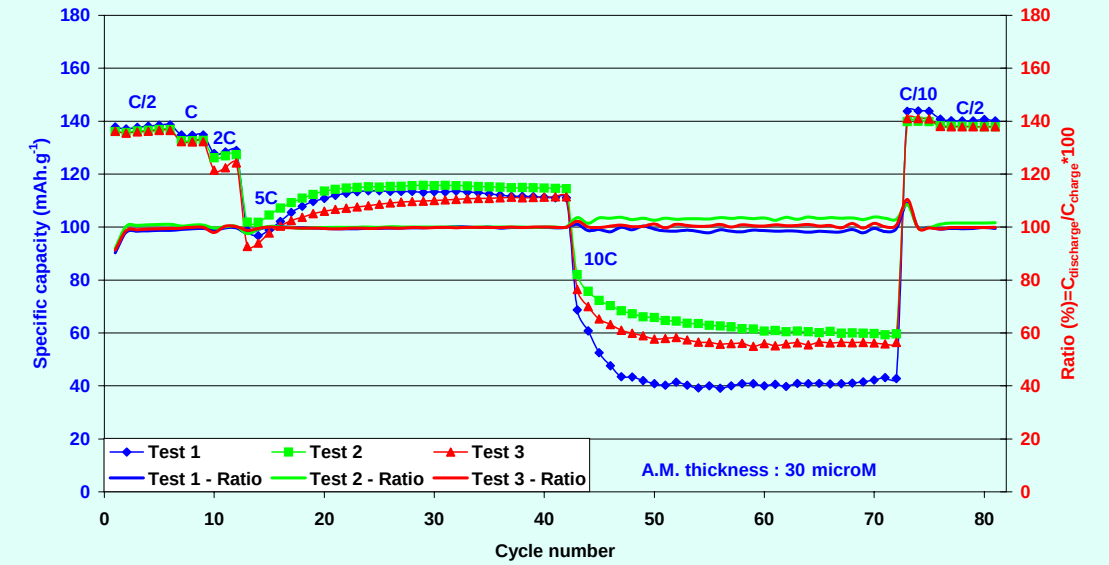
The table below shows a comparison of nickel metal hydride (NiMH) and *n*Gimat nanomaterials-based Li ion battery chemistries. Since cathode powder costs can comprise up to 25-30% of total lithium ion battery costs, our low-cost NanoSpray Combustion Processing technology presents a unique advantage in scale up if manufacturing costs of <$0.50/kWh are to be realized. Additionally, our technology presents a unique advantage with its superior rate capability and energy density, and allows us to compete in the hybrid electric vehicle market, which is expected to exceed 4.5 million units by 2013. This means the market size can be estimated at >$40 billion and growing in the next seven to ten years.

Projected Mass Production Battery Chemistry Comparison

Parameter	Ni MH*	*n*Gimat Li ion
Wh/kg: Nominal gravimetric energy density	60	130
Cell voltage (V)	1.25	3
Rate capability (C)	5	5-10
Operating T (°C)	-20 to 60	-20 to 60
Consumer Cost per kWh	19.50	5

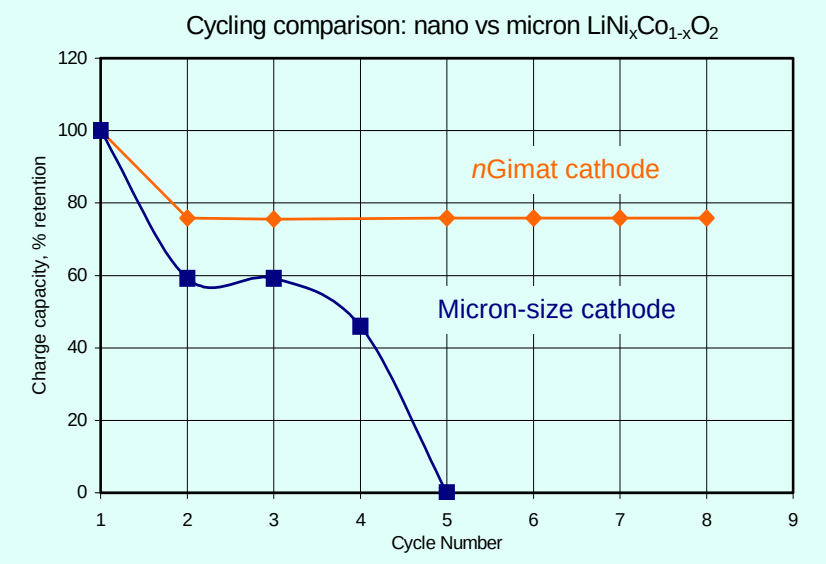
*http://www.batteryuniversity.com/parttwo-51.htm

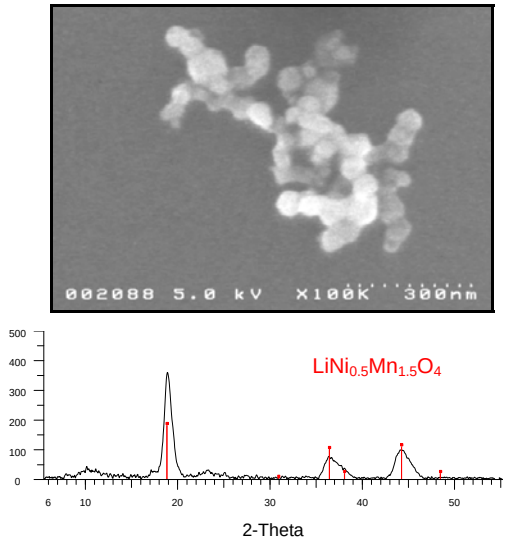
The graph shows cycling behavior of our nano-size lithium titanate anode material. Coulombic charge efficiency is excellent, hovering around 100% and indicating efficient and rapid insertion and extraction of lithium independent of rate. A rate capability of 110-115 mAh/g at 5C shows excellent promise toward uses in moderate to high rate applications. While capacity at 10C rate is 60 mAh/g, this can be enhanced in a straightforward manner with optimization of agglomeration structure.



The graph below left shows cycling stability data comparing micron-size $LiNi_xCo_{1-x}O_2$ to *n*Gimat's corresponding nanomaterial. After some first cycle loss, *n*Gimat's material has excellent charge capacity retention beyond cycle 2 while the micron-sized active material has catastrophic fade after just four cycles.

The figures at right show an SEM image of nano-size $LiNi_xMn_{2-x}O_4$ powders and associated powder x-ray diffraction pattern. Active material domains appear on the order of 50 to 60 nm with significant necking indicating high surface area with good intergrain contact for ion transport. The spinel phase that matches with the powder indicates straightforward synthesis of the desired structure for the active 5V oxide material.





The Company. *n*Gimat, located inside the perimeter of Atlanta, is an intellectual property and manufacturing company that engineers nanopowders, thin films, and devices. Our facilities are equipped with instrumentation to perform cutting edge materials research, development, and manufacturing. The scientists and engineers at *n*Gimat bring backgrounds in materials science, chemistry, physics, mechanical/chemical/electrical engineering, and biochemistry to the challenges of engineering nanomaterials. In addition, our analytical personnel provide rapid turn-around times and state-of-the-art materials analysis to support our materials development.

For more information on *n*Gimat's battery nanomaterials,
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