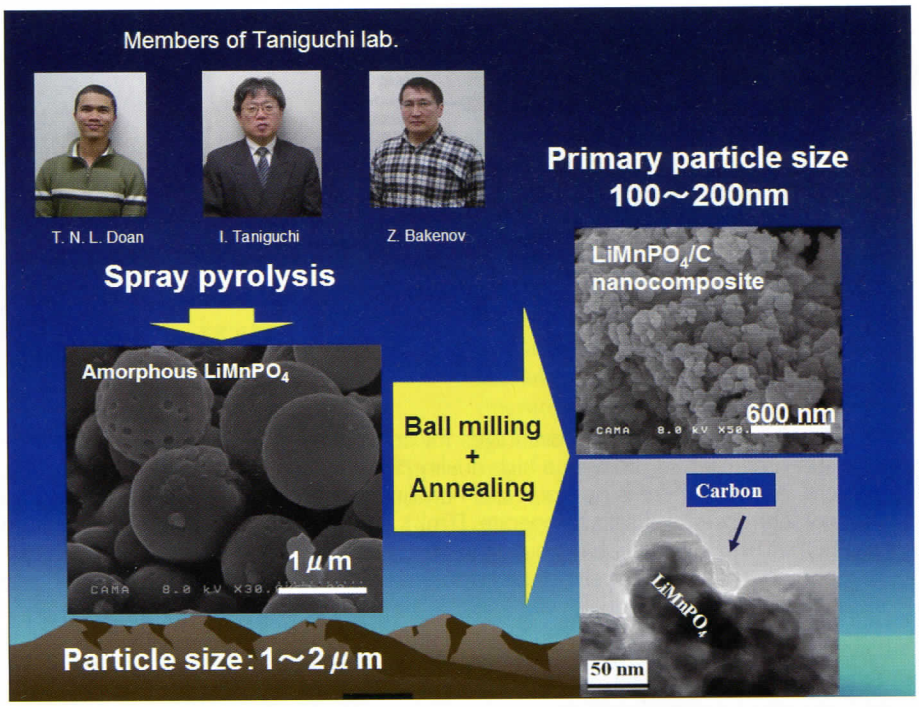
High-Output Lithium-ion Battery Electrode

A Tokyo Institute of Technology research group has succeeded in producing, through functional material processing based upon aerosol use, a nanocomposite electrode for the rechargeable lithium-ion battery which promises to be of practical use in electric vehicles and other such applications. Led by Dr. Taniguchi Izumi of the Department of Chemical Engineering located at the University's Ookayama campus, the researchers found a way to produce the electrode which is seen making possible an energy output of 90% of theoretical range. To date, other types of electrode for the rechargeable battery being researched have much lower output capacities.



COURTESY OF DR. TANIGUCHI IZUMI

The electrode is produced by making use of the olivine structure, which is a lithium manganese phosphate exhibiting high stability as a structure. Until now there has been research ongoing on $LiFePO_4$ but at most a voltage of 3.4V for a battery using this material has been realized. However, the Taniguchi team prepared the "more difficult to process" olivine-structured $LiMnPO_4$ (having a much lower electronic conductivity than $LiFePO_4$) for use as the functional material in their new lithium-ion battery electrode. Actually, the conventional lithium-ion battery available for use with portable electronic devices uses lithium cobalt oxide, in which cobalt is a rare element; thus, widespread use for the electric vehicle as well as the Smart Grid has been hampered.

The Taniguchi lab developed an innovative method—a combination of spray pyrolysis using aerosol technology along with wet ball-milling, followed by heat treatment—that could produce nanocomposite powders which mixed high crystalline $LiMnPO_4$ nanoparticles with carbon effectively. The $LiMnPO_4$/C nanocomposite powders attained electrochemical properties that were usable with their lithium-ion battery prototype. By adopting the resultant electrode into the battery, a voltage of approximately 4.1V was achieved in addition to the marking of a high percentage of energy output, ninth-tenths of the theoretical maximum output.

Dr. Taniguchi says he hopes industry will soon be able to find ways to produce the electrode en masse by adapting the manufacturing systems. Dr. Taniguchi's effort, to make possible a rechargeable lithium-ion battery well-suited for use with the electric vehicle, Smart Grid and other applications, was supported in part by the New Energy and Industrial Technology Development Organization (NEDO). NEDO clearly has targeted the support well since not only can a higher electrical capacity for a battery be realized with the Taniguchi electrode but also the ability to be recharged repeatedly even at high temperatures (up to around 50–60°C) without depleting rare materials such as cobalt holds great promise.

Prior to assuming his current position, Dr. Taniguchi spent some time as associate professor at the Tokyo Institute of Technology International Cooperation Center for Science and Technology. As such, he has been working closely with researchers who have come from overseas to study at the top-level research institution. His research team members Dr. Zhumabay Bakenov and The Nam Long Doan studied $LiMnPO_4$/C nanocomposite powder preparation. The Nam Long Doan is a scholarship student in the ASEAN University Network/Southeast Asia Engineering Education Development Network (AUN/SEED-Net) project of the Japan International Cooperation Agency (JICA).

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