

## Morphology control of Lithium ion battery electrode with nano materials by using continuous kneading process.

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Performance of lithium ion battery (LiB) highly depends on the morphology of electrodes. Therefore, the morphology control is important in LiB producing process. Especially, various properties of electrode slurry that contained nanomaterials play important role to control the electrode morphology. A batch operation is generally used as a conventional method to mix and control the slurry. However the conventional process has some problems, such as long operation time to make dispersion slurry, large space for manufacture machines and the need of skilled operators. A more efficient battery production process is indispensable in order to realize a full potential energy storage, electric vehicles and large capacity batteries. We tried applying the continuous kneading operation to achieve the efficient production process.

Li(Ni,Mn,Co)O<sub>2</sub>(NMC) and LiFePO<sub>4</sub>(LFP) were chosen as cathode active materials, and the cathode slurries were prepared by the continuous kneading operation. A closed horizontal twin screw type kneading machine was used in the continuous operation. The twin screws are constructed of many paddles which are mounted on the twin shafts. The battery performance of coin type and laminated pouch type cell using those obtained slurries were also evaluated and compared. In the experiments, we confirmed the influence of the condition for continuous kneading, the paddle arrangement in the kneader and dosing pattern of materials on the electrode morphology, battery performance and slurry properties.

As the results, we could get the suitable slurries for LiB electrode by using the continuous kneading process. The rate characteristics of laminated pouch type cells made by the continuous kneading process showed better than those made by the batch process. The cycling performance of cells made by the continuous kneading process was also better than those made by the batch process. The results confirm the advantage of continuous process not only in improving the battery performance, but also in the reduction of equipment space and slurry operation time.

Our experiments demonstrated that the continuous kneading process can produce suitable electrode slurry and control the morphology of the electrode to get better LIB. I will talk about the continuous kneading process, the battery performance and the morphology of electrode in detail in my presentation.