Abstract

Title of Document:	Porous Electrodes with directionally aligned macropores for higher energy density Li-ion batteries Rishabh Mathur, M.Tech, 2020
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Lithium ion batteries have gained popularity in various energy storage applications such as automotive and consumer electronics. Market demands are driving a continuous increase in the energy density of these batteries. The amounts of active materials largely determine battery capacity; increasing electrode thickness although offers a higher percentage of the active loading, however, its specific capacity gets lower due to improper utilization of the active material due to mass diffusion limitations.

Using bimodal electrodes having both highly directional macropores ($> 1\mu m$) and isotropic micropores ($< 1\mu m$) is one approach of reducing diffusion resistance and enhancing performance. Due to lesser control of existing fabrication technologies on the macropore size and pitch, the detailed study of effect of their orientation and distribution is scarcely available in literature.

In our work, parametric study of macropore size, pitch and electrode thickness was done numerically to find the effect of the directionality of pores on Li-ion transport and battery capacity of LCO battery, for various discharge rates. Based on the study, optimal microstructure design is suggested.

Also, we propose a novel technique, to make such bimodal electrodes. This technique uses the electro-polishing method for tool fabrication which are then used to punch holes/channels in the electrode slurry. The optimal design offers 15% enhancement in energy density.