

MATERIALS SCIENCE

# Structural, mechanical, and electrochemical properties of Li-ion battery cathodes based on Li<sub>1-x</sub>Co<sub>x</sub>O<sub>2</sub> and Li<sub>1-x</sub>Ni<sub>x</sub>O<sub>2</sub>

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Cathodes for Li-ion batteries (LIBs) are critical components that determine the energy density and cycle life of the battery. The performance of LIBs is strongly dependent on the structure and composition of the cathode material. In this work, we investigate the structural, mechanical, and electrochemical properties of Li-ion battery cathodes based on Li<sub>1-x</sub>Co<sub>x</sub>O<sub>2</sub> and Li<sub>1-x</sub>Ni<sub>x</sub>O<sub>2</sub>. We show that the mechanical properties of the cathodes are strongly dependent on the structure and composition of the material. The electrochemical properties of the cathodes are also strongly dependent on the structure and composition of the material. Our results show that the mechanical and electrochemical properties of the cathodes can be tuned by controlling the structure and composition of the material. This work provides a new perspective on the design of LIB cathodes and may lead to the development of high-performance LIBs.

INTRODUCTION

Li-ion batteries (LIBs) are the most widely used rechargeable batteries in portable electronics and electric vehicles. The performance of LIBs is strongly dependent on the structure and composition of the cathode material. In this work, we investigate the structural, mechanical, and electrochemical properties of Li-ion battery cathodes based on Li<sub>1-x</sub>Co<sub>x</sub>O<sub>2</sub> and Li<sub>1-x</sub>Ni<sub>x</sub>O<sub>2</sub>. We show that the mechanical properties of the cathodes are strongly dependent on the structure and composition of the material. The electrochemical properties of the cathodes are also strongly dependent on the structure and composition of the material. Our results show that the mechanical and electrochemical properties of the cathodes can be tuned by controlling the structure and composition of the material. This work provides a new perspective on the design of LIB cathodes and may lead to the development of high-performance LIBs.

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100; 300 a... 10; 20 (2),  
 a... a... a... a... a...  
 a... a... a... a... a...  
 (C) (2). CNC  
 (0, 1) a N (2) a C  
 (2, 2)  
 a... a... a... a... a...  
 a... a... a... a... a...  
 L(+)- A/CNC  
 a... a... a... a... a...  
 a... a... a... a... a...  
 CNC a CNC  
 L(+)- A CNC

... CNC a FC-CNC, ...  
 ... CNC i CNC- ... CNC-  
 ... 67. 22 a 31. 11%, ... (i, 5). B  
 ... OMa ...  
 ... CNC i CNC (A ...),  
 ... (Fi. 3, Aa B).

... Δ ...  
 ... 50-μ ...  
 ... Ma ...  
 ... F ...

... a 37. Ma ... A. 2, 4, A. 6 ... NC-6 ... ) 75

... OMi a, ... Fi. 3A, a-  
 ... CNC i a  
 ... CNC- ... O ...

10.1126/sciadv.abc1234



$$E + F \rightarrow 2F, v_7 = k_7, k_7 = 10^3 \quad (8)$$

where  $A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z$  are the species concentrations.

The A-CNC reaction is given by (E.5a-6).

$$E.1. \quad r_i = \sum_{j=1}^7 (v_j^r - v_j^f) v_j$$

where  $v_j^r$  and  $v_j^f$  are the forward and reverse reaction rates.

The A-CNC reaction is given by (E.2a-4).

The A-CNC reaction is given by (E.3).

The A-CNC reaction is given by (E.4).

The A-CNC reaction is given by (E.5).

The A-CNC reaction is given by (E.6).

The A-CNC reaction is given by (E.7).

The A-CNC reaction is given by (E.8).

The A-CNC reaction is given by (E.9).

The A-CNC reaction is given by (E.10).

The A-CNC reaction is given by (E.11).

The A-CNC reaction is given by (E.12).

The A-CNC reaction is given by (E.13).

The A-CNC reaction is given by (E.14).

## DISCUSSION

The reaction network is analyzed using the method of moments.

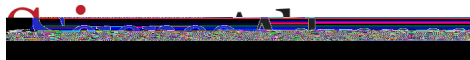
... CNCa ... A ...  
... H ... A  
... CNC ...  
... CNC ... (50).  
... A/CNC ...

... (i) ...  
... /CNC ... 0 ... 0  
... .5NC6(Fi . 371E) ... /C ... (0.005 , 9 45 5901 ... )0. ...

(-N41001 H :F),  $\Delta$  a e, i a i i  $\Delta$  a b e, i, i  
480. 23  
EM i a, i, i  
A/CNC ( = 4.5)  
H = 23%. B  
FEG 250  
3  
90  
AFM  
A/CNC (







## Self-organization of nanoparticles and molecules in periodic Liesegang-type structures

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