Showcasing research from Shengyu Tao, Xuan Zhang, Yang Li, Guangmin Zhou, Tsinghua Shenzhen International Graduate School, Tsinghua University, Shenzhen, China.

Non-destructive degradation pattern decoupling for early battery trajectory prediction *via* physics-informed learning

Manufacturing uncertainties impede the transition from material prototypes to commercial batteries, making quality verification critical. Challenges persist in decoupling microscopic interactions to establish a quantitative mapping from electrochemical parameters to macroscopic performance. This paper proposes a physics-informed learning model that quantifies future thermodynamic and kinetic parameters that have not been established at verification time. Using the quantified parameters, the model predicts life-long battery degradation trajectories from early-stage signals with minimal error. This paper shows promises in facilitating sustainable battery manufacturing, reuse, and recycling *via* physics-informed learning in a non-destructive manner.

As featured in:

See Xuan Zhang, Yang Li, Xiaosong Hu, Guangmin Zhou *et al.*, *Energy Environ. Sci.*, 2025, **18**, 1544.

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