

Carbon Fibers based Composite Lithium Anode for Lithium Metal Batteries

Rui Zhang^a, Xiang Chen^a, Xin Shen^a, Xue-Qiang Zhang^a, Xiao-Ru Chen^a,
Xin-Bing Cheng^{a,*}, Chong Yan^a, Chen-Zi Zhao^a, Qiang Zhang^{a,*}

^a Beijing Key Laboratory of Green Chemical Reaction Engineering and Technology,
Department of Chemical Engineering, Tsinghua University, Beijing 100084, P.R. China

E-mail: zhang-r15@mails.tsinghua.edu.cn

Lithium (Li) metal is among the most promising anode materials in next-generation high-energy-density energy-storage-systems due to its ultrahigh theoretical specific capacity of 3860 mAh g⁻¹ and the lowest negative electrochemical potential (-3.040 V vs. the standard hydrogen electrode).^[1] However, Li dendrite growth and unstable solid electrolyte interphase (SEI) have hindered its practical applications.

Structured current collectors have been widely proposed to settle these issues,^[2,3] whereas the pre-filling of Li metal into structured anode is challenging. We proposed silver (Ag)-coated carbon fibers (CF) based composite Li anode (CF/Ag-Li) through Ag electroplating and Li molten infusing (**Fig. 1**). Not only the molten Li can infuse into carbon fiber framework to obtain a Li-containing structured electrode due to the lithiophilic nature of Ag, but also a dendrite-free morphology and extraordinary electrochemical performance are achieved during Li stripping/plating cycles in Li-LiFePO₄ and Li-sulfur (Li-S) cells. The CF/Ag-Li | Li symmetrical cells can cycle for more than 160 cycles with a low hysteresis at an extremely high current density of 10 mA cm⁻² and an ultrahigh cycling capacity of 10 mAh cm⁻². The CF/Ag-Li | LiFePO₄ cells exhibited stable cycles with high specific capacity for more than 500 cycles at 1 C. The CF/Ag-Li | S cells exhibited a very high initial discharge capacity of 785 mAh g⁻¹ and a higher capacity retention rate than ultrathin Li foil | S cells after 400 cycles at 0.5 C.

As a conclusion, initially Li-containing structured anodes like CF/Ag-Li electrodes are promising for high-energy-density full cells like Li-S and Li-O₂ batteries, which sheds new light on the dendrite-free plating of Li metal anodes in working rechargeable batteries.

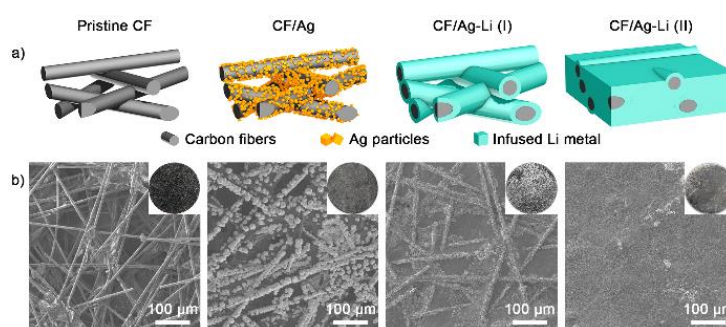


Figure 1. Fabrication of CF/Ag-Li composite anode. (a) Schematic diagrams, (b) SEM images, and (inset figures) digital photos for pristine CF, CF with electroplated Ag (CF/Ag), CF/Ag with molten Li infused at the surface of CF (CF/Ag-Li (I)), and Li fully infused in CF framework (CF/Ag-Li (II)).

References:

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