In summary, a wearable and flexible nanoporous AuNSs/PC SERS substrate was designed by using the ion-track etched PC membrane as a reaction generator for synthesizing AuNSs on the membrane surface. The nanoporous SERS substrate displayed excellent SERS signal homogeneity. The prepared SERS substrate also exhibited good chemical stability and mechanical property. It can be used repeatedly by using the developed cleaning procedure to lower usage costs. Most importantly, benefiting from the nanoporous structure, the substrate can be adopted as a sweat sensor to monitor the contents (like uric acid, lactic acid, *et al.*) in human sweat even without liquid-form sweat releasing, which is extremely meaningful for the bedridden person or the people who could not do strenuous exercise to realize the non-invasive health monitoring.

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5 - 27 Ion Track-Based Low-Tortuosity and High-Porosity 3D Metallic Electrodes for Long-Life Lithium Anodes

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Lithium (Li) metal anodes are the most promising candidate for next-generation energy storage batteries with high energy-density. However, Li metal anodes suffer severe Li dendrite issues, signifficant capacity degradation as well as severe safety problem, which hinder their further commercial applications[1].

Numerous studies show that the uniformity of electric field highly affects the transfer rate of Li^+ and electrons and the local current density during Li deposition process, which in turn has an important effect on the formation of Li dendrites[2]. Therefore, 3D Li-host has been proposed as an effective strategy to relieve lithium dendrite issues, because 3D host (such as woven Cu mesh, 3D Cu foam, and 3D Ni foam) by utilizing the porosity of the electrode can effectively homogenize the electric field and Li^+ flux as well as availably relief the tremendous volume expansion during the charge-discharge processes. However, those Li-based composite anodes mainly possess random-arranged structure with high-tortuous pathways, leading to low ion transport and poor rate capabilities. Thus, it's highly desired to develop 3D Li-host anodes with low-tortuosity and high-porosity for high-power-density and high-energy-density.

In this report, based on ion track technology, a highly interconnected 3D Cu matrix with both low-tortuosity (1.3) and high-porosity (81.5 %) was fabricated to redistribute electric field and Li^+ flux in Li anodes (Fig. 1(a)). According to our new study[3], 3D Cu matrix could have excellent energy absorption capacity and compressive strength. Furthermore, 3D Cu matrix combined with lithiophilic $CuAu_x$ nanocrystals to form 3D metallic Cu&$CuAu_x$ matrix, which can highly lower the lithium nucleation barrier. As a consequence, due to its large surface area and ultrahigh porosity, the as-prepared 3D metallic Cu&$CuAu_x$ matrix can effectively reduce the local current density and Li nucleation barrier during Li deposition process. Furthermore, finite element simulation reveals that the unique 3D Cu&$CuAu_x$ structure can efficiently homogenize the electric field and Li-ion flux as well as reduce the lithium-ion concentration gradient in Li anodes. As a result, the composite 3D Cu&$CuAu_x$-Li anodes exhibit ultrahigh cycle life more than 2 100 hours (Fig. 1(b)). The long cycle life performance and rate capabilities significantly surpassed most of 3D hosts. As shown in Fig. 1(c), the full cells based on 3D Cu&$CuAu_x$-Li anodes and $LiFePO_4$ cathodes also demonstrate a stable cyclic performance (200th cycle) and have better capacity retention than Cu-Li//LFP and 3D Cu-Li//LFP.

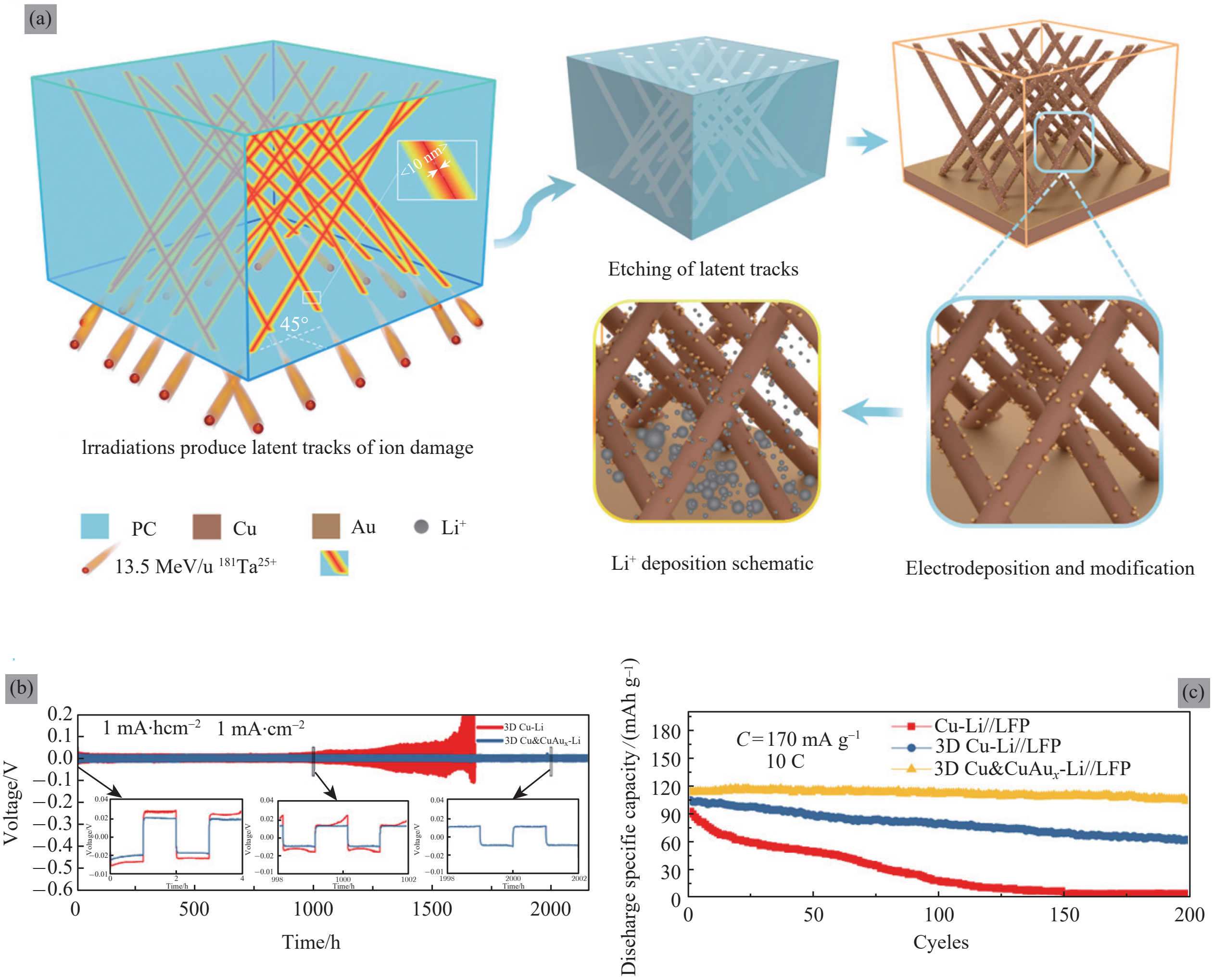

Fig. 1 (color online) (a)Summary schematic of the 3D metallic matrix current collector fabrication, formation, and attraction of Li deposition, (b) Cyclic properties for symmetric cells with 3D Cu-Li and 3D Cu&CuAu$_x$-Li composite anodes, respectively, (c) Cyclic performance of Cu-Li//LFP, 3D Cu-Li//LFP and 3D Cu&CuAu$_x$-Li//LFP full cells at 10 C ($C = 170$ mA·g^{-1}), respectively.

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