New approach enables faster testing of urea in body fluids

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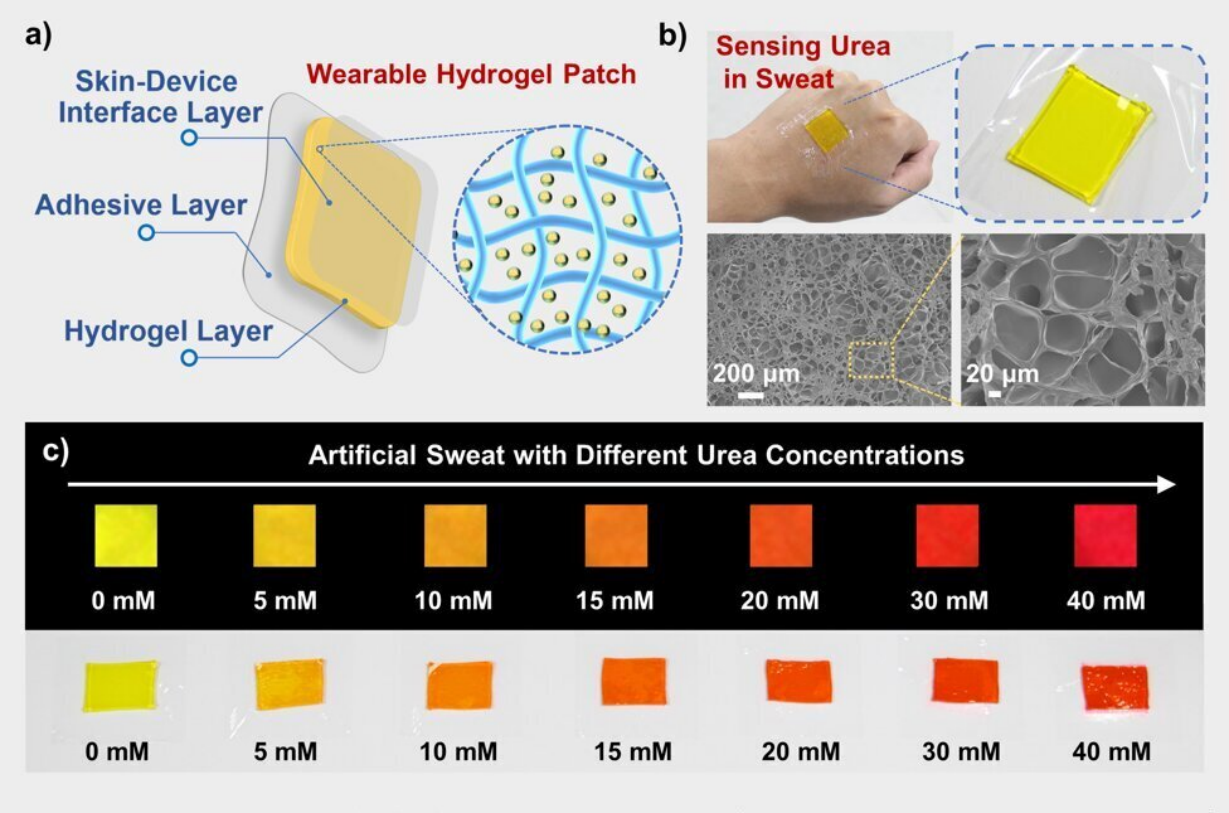

Designed wearable hydrogel sensing patch and response of hydrogel sensing patch to urea under 980 nm excitation and daylight. Credit: Kang Xiaohui

A research team from the Hefei Institutes of Physical Science (HFIPS) of the Chinese Academy of Sciences has developed a wearable sensing

patch and realized rapid quantitative analysis of urea.

The findings were published in *Analytical Chemistry*.

Urea, excreted through sweat, urine, saliva and blood, is considered an important indicator of renal function in clinical diagnosis. Effective detection of urea levels is critical for early detection of disease. Wearable fluorescence-based sensors have attracted much attention from users, but traditional fluorescent hydrogels are excited by short wavelengths. Spontaneous and background fluorescence can easily interfere with the detection of biological samples.

Therefore, upconversion nanoparticles (UCNPs), which can eliminate the self-fluorescence and background interference of biological samples, are an effective strategy to detect human biomarkers with high sensitivity.

"We embedded an upconversion optical probe into a three-dimensional porous polyacrylamide (PAM) hydrogel, and combined the patch with a smart phone color reader," said Prof. Jiang Changlong, who led the team.

The PAM hydrogel sensor was based on an upconversion optical probe, which was composed of UCNPs and p-dimethylamino-cinnamaldehyde (p-DMAC). Due to the internal filtration effect, the red product produced by the reaction of urea and p-DMAC quenched the green fluorescence of the UCNPs and caused the upconversion fluorescence to change from yellow to red, thus realizing the fluorescence detection of urea.

On this basis, a flexible wearable sensor was fabricated by combining PAM hydrogel, and a portable sensor platform was constructed using 3D printing technology.

The limits of detection of the self-designed upconversion fluorescent probe and the hydrogel sensor were only 1.4 μM and 30 μM, respectively. They were much lower than the urea content in sweat, implying higher sensitivity.

The design of the sensor patch allows for convenient and accurate sensing strategy for the detection of biomarkers in body fluids, and has the potential to be developed into a device for providing disease warning and clinical diagnosis, according to the team.

More information: Bin Hu et al, Multiplex Chroma Response Wearable Hydrogel Patch: Visual Monitoring of Urea in Body Fluids for Health Prognosis, *Analytical Chemistry* (2023). DOI: 10.1021/acs.analchem.2c03806

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