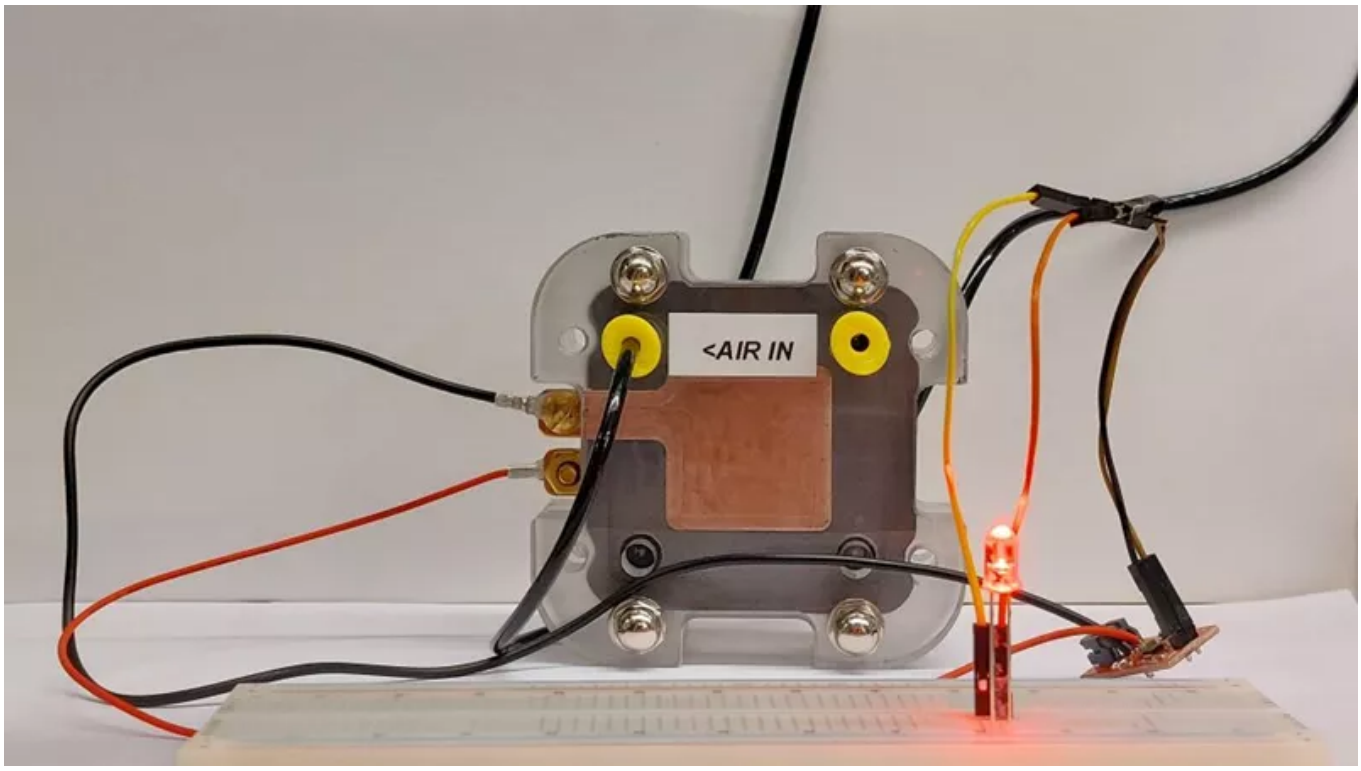
Materials Energy & environment

Protein in chicken feathers repurposed for fuel cell membrane

News | 2 min read

Scientists have extracted a protein from chicken feathers to make a membrane that could be used in fuel cells.



The researchers tested their feather-based membrane by assembling it in a commercial fuel cell setup - *NTU Singapore/ETH Zurich*

The researchers from Nanyang Technological University, Singapore (NTU Singapore) and ETH Zurich, Switzerland created a thin membrane capable of conducting protons by extracting the protein keratin from chicken feathers, then processing it into ultra-fine amyloid fibrils. The membrane could also have potential application in electrolysis, the team said.

The researchers, led by Professor Ali Miserez from NTU's School of Material Science and Engineering and School of Biological Sciences, and NTU Visiting Professor Raffaele Mezzenga, said their membrane reduces carbon emissions from the burning of unwanted chicken feathers and is produced sustainably. The team's research is detailed in *ACS Applied Materials & Interfaces*.

In a statement, Professor Ali Miserez said: "The poultry industry generates millions of tons of unwanted chicken feather waste, which is burnt off in disposal, releasing large amounts of carbon dioxide and toxic gases such as sulphur dioxide. Our membrane reduces such emissions by repurposing the feathers into further green applications in fuel cells. The membrane not only has a negative carbon footprint from its production, but can operate without further carbon dioxide emissions when used in a fuel cell."

Fuel cells contain a semipermeable membrane that allows protons to pass through but not electrons, which flow through an external circuit from the anode to cathode. However, producing such membranes in conventional fuel cells uses so-called 'forever chemicals', which are expensive and do not break down in the environment.

The keratin-based membrane developed by the NTU and ETH team is claimed to be environmentally friendly as it is composed of a biological material and created in a green process that does not produce carbon emissions.

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Professor Raffaele Mezzenga said: “Our latest development closes a cycle: we are taking a substance that releases carbon dioxide and toxic gases when burned and using it in a different setting: with our new technology, it not only replaces toxic substances but also prevents the release of carbon dioxide, decreasing the overall carbon footprint cycle.”

The paper’s first author, NTU PhD student Mr Soon Wei Long, said: “The extraction process is both fast and economical. Chicken feathers are 90 per cent keratin, which is the useful protein we want due to its high cysteine amino acid content. When burnt, cysteine produces highly toxic sulphur dioxide; however, the cysteine itself is crucial in allowing for the membrane's high proton conductivity when treated. We are turning something that is toxic when disposed of into something sustainable when used in this membrane.”

In their study, feather keratin is first isolated from an alkaline extract of chicken feathers. This keratin is heated up and converted into protein amyloid fibrils, which are rope-like nanostructures made of tightly wound proteins.

These nanofibrils are then further processed into membranes and treated in acid, where they undergo a chemical reaction that allows them to conduct protons.

The large amount of industrial chicken feather waste produced by the poultry industry also means that the membrane manufactured in the laboratory could be up to three times cheaper than conventional membranes to produce. The researchers say it takes 100g of feathers to make 1m2 square metre of membrane, which is 80µ thick.

The researchers tested their feather-based membrane by assembling it in a commercial fuel cell setup. In their tests, the fuel cell could turn on an LED lamp, spin a small fan, and power a small toy car.

The researchers’ next step will be to investigate how stable and durable their keratin membrane is and to improve it.

fuel cells

20 Oct 2023

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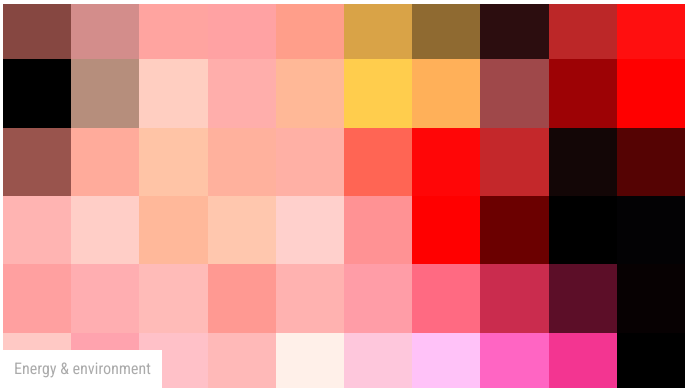

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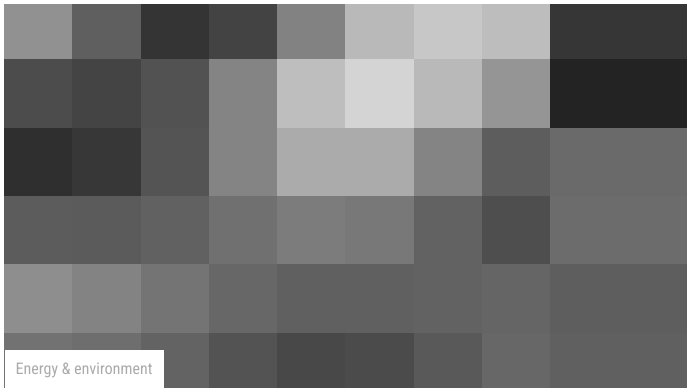

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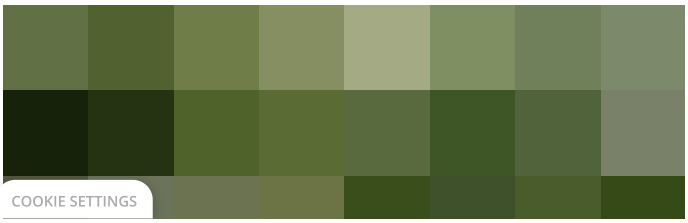

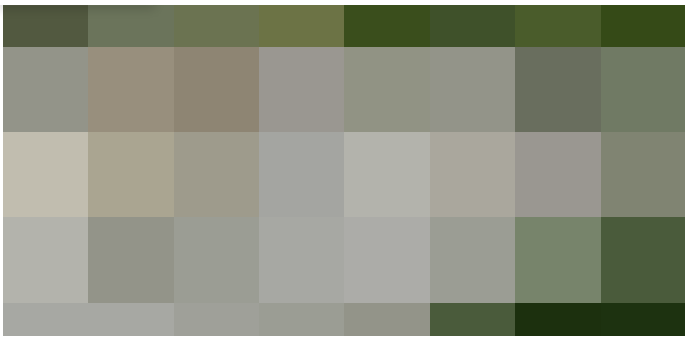

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My apologies for querying the article, again, but it does say that "..energy density (around eight times) than jet fuel, " whereas the Wiki (and elsewhere) suggest that the energy densities for LH2...

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