

BIOMATERIALS

CRISPR turns gels into biological watchdogs

Gene-editing tool used to trigger smart materials that can deliver drugs and sense biological signals.

BY EWEN CALLAWAY

Is there anything CRISPR can't do? Scientists have wielded the gene-editing tool to make scores of genetically modified organisms, as well as to track animal development, detect diseases and control pests. Now, they have found yet another application for it: using CRISPR to create smart materials that change their form on command.

The shape-shifting materials could be used to deliver small molecules, and to create sentinels for almost any biological signal, researchers reported on 22 August (M. A. English *et al. Science* 365, 780–785; 2019). The study was led by James Collins, a bioengineer at the Massachusetts Institute of Technology in Cambridge.

Collins's team worked with water-filled polymers that are held together by strands of DNA, known as DNA hydrogels. To alter the properties of these materials, Collins and his team turned to a form of CRISPR that uses a DNA-snipping enzyme called Cas12a. (The gene editor CRISPR–Cas9 uses the Cas9 enzyme to snip a DNA sequence at the desired point.) The Cas12a enzyme can be programmed to recognize a specific DNA sequence. The enzyme cuts its target DNA strand, then severs single strands of DNA nearby.

This property allowed the researchers to build a series of CRISPR-controlled hydrogels

containing a target DNA sequence and single strands of DNA, which break up after Cas12a recognizes the target sequence in a stimulus. The break-up of the single DNA strands triggers the hydrogels to change shape or, in some cases, completely dissolve, releasing a payload (see 'CRISPR-controlled gel').

SMART OBJECTIVES

The team created hydrogels programmed to release enzymes, small molecules and even human cells — for instance, as part of a therapy — in response to stimuli. Collins hopes that the

gels could be used to make smart therapeutics that release, for example, cancer drugs in the presence of a tumour, or antibiotics around an infection.

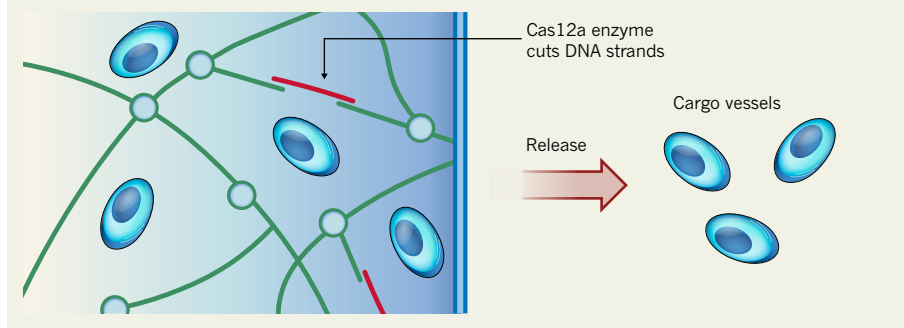
The researchers also integrated CRISPR-controlled hydrogels into electronic circuits. In one approach, they placed hydrogels inside a small chip-like device called a microfluidic chamber that was linked to an electronic circuit. The circuit switched off in response to the detection of genetic material from pathogens including the Ebola virus and methicillin-resistant *Staphylococcus aureus* (MRSA). The team even used the hydrogels to develop a prototype diagnostic tool that sends a wireless signal when it recognizes genetic material from Ebola in lab samples.

Dan Luo, a bioengineer at Cornell University in Ithaca, New York, says that the CRISPR hydrogels are an improvement on other responsive hydrogels because scientists can easily determine what triggers a change in the material.

"We're in the CRISPR age right now," Collins says. "It's taken over biology and biotechnology. We've shown that it can make inroads into materials and bio-materials." ■

CRISPR-CONTROLLED GEL

Researchers have created a smart hydrogel material that is held together by DNA. The CRISPR–Cas12a protein cuts the DNA strands, changing the gel's shape, which can be controlled to release drugs, particles or even switch an electronic circuit.



DENMARK

Geologist's sacking prompts outcry

Tenured professor dismissed from University of Copenhagen.

BY QUIRIN SCHIERMEIER

For the second time in three years, geoscientists are protesting against the dismissal of a geologist from the University of Copenhagen.

The management of the university's science faculty dismissed Irina Artemieva,

a tenured professor and internationally esteemed specialist in lithospheric geophysics, on 29 July — saying that she has repeatedly failed to fulfil various administrative and teaching duties. They allege that she has failed to use the appropriate calendar to plan holidays; travelled to conferences without approval; and caused inconvenience to

examination and teaching schedules. "Your actions and behaviour have had a negative impact on the performance of your duties relating to teaching and research activities in overall terms," the faculty told Artemieva in the July letter informing her of her dismissal.

Artemieva denies the accusations, and defended herself in a 128-page document sent to the faculty of science after the management informed her in May that it was contemplating her dismissal. She says that all her external work activities, including field trips, conference attendance and editorial work, are standard professional undertakings that she has documented as required by the university's rules.

An international group of 32 geoscientists says that the university's action is problematic because the reasons given do not warrant the dismissal of a tenured professor, by international academic standards. This — combined

IRINA ARTEMIEVA

with the similar dismissal of another geologist three years ago from the same faculty, which geoscientists also protested about — threatens the reputation of the University of Copenhagen and the Danish university system, they say in a July letter sent to the university after it had told Artemieva that it was considering her dismissal.

In 2016, the faculty's management sacked Hans Thybo, a prominent geologist who was, at the time, president of the European Geosciences Union, over his use of a private e-mail account for work purposes. A group of geoscientists similarly criticized that sacking, and urged the university to reconsider its decision. Thybo, now a researcher at the University of Oslo, appealed against the sacking, and received a settlement of six months' salary after arbitration discussions between the university and a trade union representing academic employees — but he was not reinstated to his post.

PERSONAL DISAGREEMENTS

"Throughout most of the developed world, a tenured professor can only be dismissed for gross misconduct or criminal activity," the group of geoscientists wrote. "Professor Artemieva's dismissal appears to be based on personal disagreements between her and



Irina Artemieva is a specialist in lithospheric geophysics.

the management of the department," the scientists wrote. "At least on these occasions, the University of Copenhagen is not adhering to the international standards of academic freedom and the rights of its employees."

"This new dismissal will damage the reputation of the university system and the country's scientific community even more than the earlier case," they wrote.

"Irina is an outstanding researcher, adviser and geoscience community member," says Seth Stein, an Earth scientist at Northwestern University in Evanston, Illinois, who organized the protest letter to the university. "Losing her would be a great loss to the geophysics programme at the University of Copenhagen."

The University of Copenhagen declined *Nature's* request for comment on the dismissal, saying that it does not discuss matters concerning individual employees. The Danish ministry for science and education also declined to comment on the case, or on the suggestion that the dismissal would harm Danish universities' reputations.

Artemieva says that her treatment has amounted to discrimination — complaints that the university says, in its letters to her, are unsubstantiated. The researcher, who is originally from Russia and was the only female professor in her department, says that she

was consistently made to feel unwelcome after gaining her tenured position through an open call for applications. "No matter what I would do, I was facing professional enmity here from the very start," she says.

In Artemieva's dismissal letter, the department's dean, John Renner Hansen, says that the faculty of science "does not recognize the picture of [Artemieva] having been exposed to 'harassment', 'bullying' and 'discrimination' since you were appointed professor". It adds: "Your actions have been confrontational and conflict-escalating... Rather than responding to the critique raised, you continue to make accusations against different management members." ■

FUNDING

Brazil budget cuts threaten 80,000 science scholarships

The country's main research-funding agency could stop payments as soon as September.

BY RODRIGO DE OLIVEIRA ANDRADE

Brazil's main science-funding agency will have to suspend more than 80,000 scholarships to postdoctoral researchers and graduate and undergraduate students starting in September unless it receives additional cash from the government.

The National Council for Scientific and Technological Development (CNPq) announced the impending cancellations on 15 August. The CNPq also won't be offering new scholarships, according to the statement. Brazil's government hasn't released the 330 million reais (US\$89 million) that it froze in the CNPq's budget as part of broader spending cuts in March. If President Jair Bolsonaro's administration doesn't release some of the

money soon, the CNPq's scholarship fund will run out of cash by next month.

"Government is jeopardizing the future of a whole generation of Brazilian scientists," says Paulo Artaxo, a physicist at the University of São Paulo. Cancelling the scholarships will have a devastating impact on Brazilian science, which depends on these young researchers, he says.

Not supporting students in research programmes "is like shooting oneself in the foot", says Alexander Turra, an oceanographer at the Oceanographic Institute of the University of São Paulo.

A MATTER OF SURVIVAL

Biologist Nicole Malinconico is one of many graduate students who might have to leave

research if the CNPq scholarships fall through. She moved to São Paulo in January and has applied to the doctorate programme at the Oceanographic Institute.

"Now, even if I enter the doctorate [programme], without the scholarship I won't be able to keep myself in São Paulo," says Malinconico. She plans to apply for a scholarship offered by the São Paulo Research Foundation, a local science-funding agency. But the competition for alternative sources of money has grown stiff, she says. Malinconico fears that she will have to give up her research career to look for a job outside academia, as many of her friends are doing.

"For many students, a scholarship is much more than research support, it is a salary that they use to live, to eat and to pay their bills," ▶