Formed from the magma of a volcanic super-eruption: The Wheeler Monument in Colorado

Supervolcanoes

SPONGY MAGMA CHAMBERS

Supervolcanoes continue to baffle researchers. Up until now, experts have been divided as to whether magma chambers in the Earth's crust under supervolcanoes consist of molten or completely solidified magma. Now ETH researchers have shown that the truth lies somewhere in the middle. Supervolcano magma reservoirs contain a mixture of both molten and solid magma – and are somewhat like soggy sponges.

Medical diagnostics

RAPID ANALYSIS IN DOCTOR'S SURGERY

Infections and metabolic disorders can be detected in blood or urine by means of complex tests in specialist laboratories. Now, scientists at ETH Zurich and the healthcare company Roche have jointly developed an innovative analytical process based on the way molecules on a small chip diffract light. This technique has the potential to revolutionise diagnostics: in future, it may enable doctors to carry out sophisticated tests easily and quickly in their own surgeries.

Just like established diagnostic procedures, the new method also uses the lock-and-key principle for molecular recognition. To determine the presence of a particular protein (the "key") dissolved in the blood, for instance, this protein must dock on to a suitable antibody (the "lock"). In traditional immunological tests, researchers then employ a second "key" marked with dye to make the "key in the lock" visible. This step is redundant in the new process, however, because laser light makes the "key in the lock" visible immediately.

In order to achieve this, the scientists use a chip with a specially coated surface. If they direct laser light along the chip's surface, the light is diffracted by the lock-key combinations and focused onto a point below the chip – where a dot of light appears.

The researchers call their new diagnostic technique "focal molography". It is substantially faster than previous analytical processes, and it is ideally suited for measuring proteins in bodily fluids or conducting analysis in real time. This opens up a vast range of potential applications.

Generates ultra-pure green light

Light-emitting diode

FOR THE PUREST GREEN

TV displays need to have the purest base colours possible. In the case of green, however, technology is being stretched to its limits. Using an ultra-thin and bendable light-emitting diode (LED), engineers at ETH Zurich have succeeded in generating ultra-pure green light for the first time. This could lead to visible improvements in the colour quality and sharpness of high definition displays for TVs and smartphones. A patent application has been submitted.

Images: Flickr / John Fowler; Sudhir Kumar, Jakub Jagielski

Rapid imaging

A LOOK INSIDE GRANULAR MATTER

Even in today's high-tech world, we still can't really predict when rockslides or earthquakes will occur – nor can we know exactly how they will evolve. This is partly due to the fact that scientists have only a basic understanding of the way gravel and sand behave, particularly when mixed with water or gases. Researchers at ETH Zurich and the University of Zurich, together with colleagues at Osaka University in Japan, have now developed a technique that could make it much easier to study such phenomena in the future.

Granular systems – a generic term for anything that resembles grains or powders – are important not just in nature but also in practical applications, such as the chemical industry. Here, production flows are frequently interrupted by unforeseen jamming or de-mixing of the granular materials used.

To overcome such obstacles, researchers at ETH reintroduced into physics research an imaging technology that is mainly used nowadays in medicine: magnetic resonance imaging (MRI). They added a number of radio antennas to a commercial MRI device, which they used to analyse what happens when gas flows through granular systems. This allowed them to capture images of the inside of agitated granular systems ten thousand times faster than had been possible before.

The gas flow causes the granular medium, which is usually solid, to behave like a fluid. This makes it possible for gas bubbles to rise, split up, or merge. Previously, it was impossible to study such processes in real time.

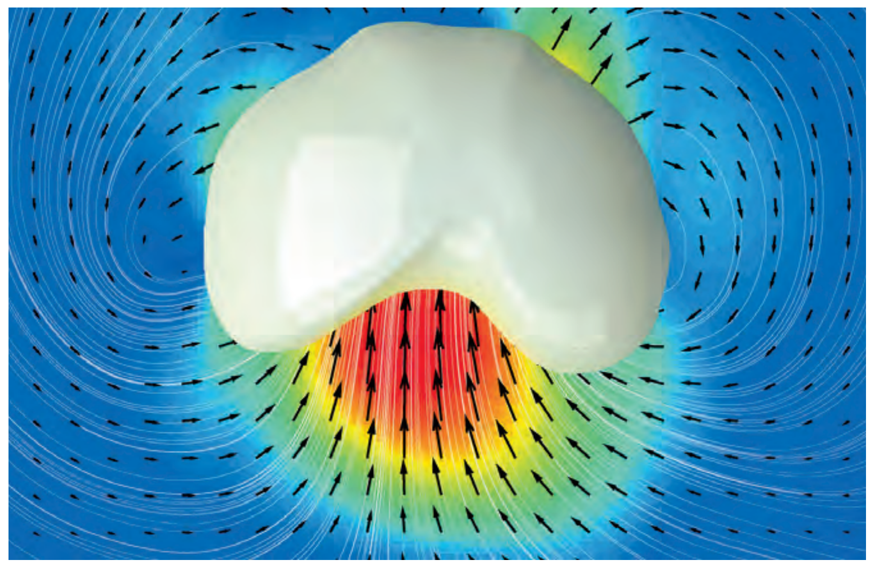

Illustration of a rising bubble inside a granular medium through which gas is flowing: the velocities of the individual particles are shown by arrows

Computer working memory

FAST MAGNETIC WRITING OF DATA

For almost 70 years, computers have stored data magnetically on tapes and hard disks. To date, however, magnetic storage technologies have been considered too slow for use in the working memory that computers use to process data. Researchers at ETH have now tested a process that makes magnetic data writing significantly faster and more energy-efficient.

In traditional magnetic storage technologies, current-carrying coils produce a magnetic field that changes the direction of magnetisation in a small area of the data carrier. It would be much more efficient to change the magnetisation direction directly, without any recourse to intermediary magnetic coils.

This is exactly what the ETH researchers have now succeeded in doing. An electric current passing through a specially coated semiconductor film inverts the magnetisation in a tiny metal dot. The process lasts less than one nanosecond, and it produces precise and repeatable results. That makes it potentially suitable for use in magnetic working memory. Magnetic RAM like this would, among other things, make the loading of the operating system obsolete when booting a computer – because programmes would remain in the working memory, even when the power is switched off.

For more information on this and other research news from ETH Zurich, please visit:
→ www.ethz.ch/news

Image: Alexander Penn