## CAPSULE

**Protein diet**
It is a puzzle why pandas have jaws and teeth characteristic of herbivores but resemble carnivores in their gut and digestive enzymes. A study published in *Current Biology* shows that they consume the bamboo at a stage when it has the highest protein content. This puts them on the same bracket as carnivores that obtain 70% of their food from animals.

**West Antarctic melt**
The melting of Antarctic ice and ensuing rise in sea level will accelerate with climate change. A study published in *Science* argues that this will be delayed by a crustal uplift in the Amundsen sea sector, which helps reduce grounding line retreat. While this won't reverse ice sheet loss, this can delay the progress of dynamic mass loss of Thwaites glacier by about 20 years.

**Bitter meal**
Bees that get dusty with pollen from the flowers they visit for nectar many times eat the protein-rich pollen. This defeats the interests of the plant, which would like the pollen spread to other flowers. Teasel (*Dipsacus* species) has evolved a distasteful saponin with their pollen. Bees when visiting teasel flowers simply gather the nectar and ignore the pollen.

# IISc team submits more evidence of superconductivity

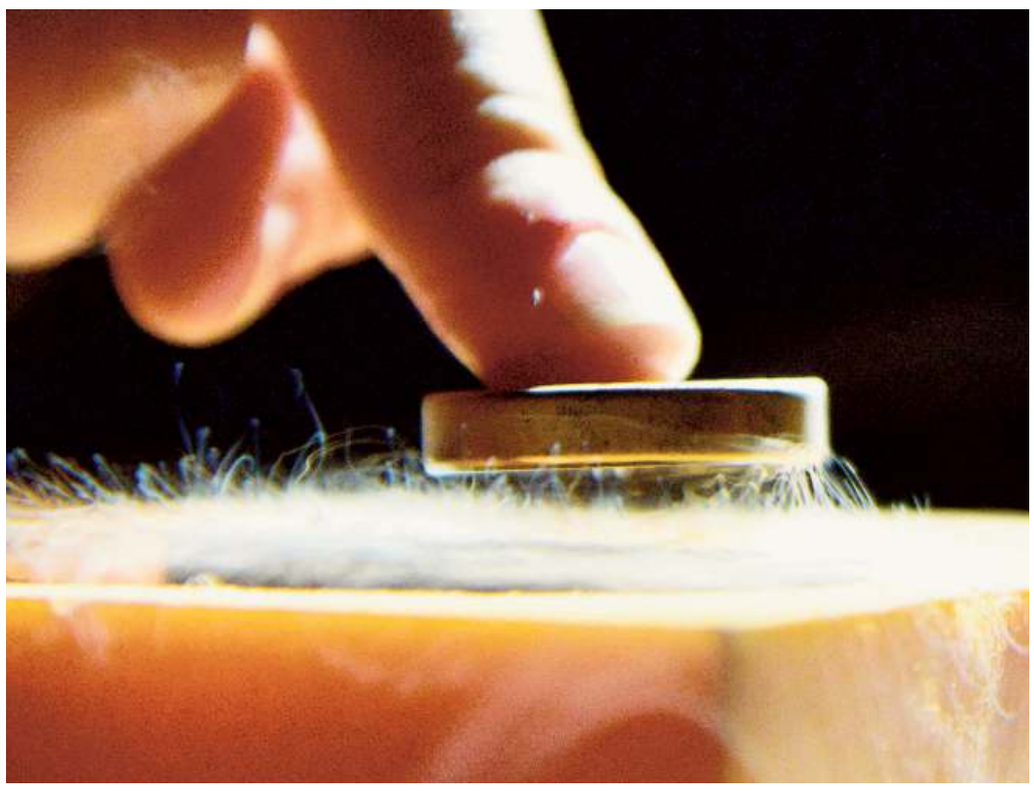
On June 5, they posted a preprint which fills up the lacunae in their previous ones

R. PRASAD

A team of Indian Institute of Science (IISc) researchers led by Prof. Arindam Ghosh from the department of Physics have presented further evidence of possible superconductivity in gold-silver nanostructures in a preprint posted on June 5 in the preprint repository arXiv. The preprint is yet to be peer-reviewed.

In a revised preprint posted on May 21 in arXiv, the IISc team had written about the material exhibiting superconductivity. "Two of the most important properties of superconductivity are diamagnetism and zero resistance. These two were seen in the material we studied. They seem to suggest that the material becomes superconducting below a certain temperature (286 K or 13 degree C). And it can go up to 70 degree C," said Prof. Ghosh. "At 286 K we have seen clear transition from a normal state to a superconducting state. This is more than anyone has reported."

However, the May 21 preprint did not furnish data on current-voltage characteristics and the evidence of critical current.



**Closing in:** Two of the most important properties of superconductivity are diamagnetism and zero resistance. These two were seen in the material we studied, said Arindam Ghosh. ▪ AFP

### Fills lacuna

The latest one posted on June 5 fills that lacuna as it has dealt with current-voltage characteristics in gold-silver nanostructures with regard to superconductivity.

What typically happens in current-voltage characteristics is that as the current is increased the voltage remains zero and at a critical current the voltage suddenly increases and superconductivity is destroyed.

"The current-voltage characteristics was one of the important data that were not presented in the earlier paper. This study shows the material has some signatures of critical current – the current at which the superconductor is no longer stable and becomes resistive," Prof. Ghosh wrote.

The IISc team observed that at a critical temperature of 160 K (-113.15 degree C) and critical current of little less than 10 milliampere the voltage suddenly shoots up and the gold-silver nanostructures no longer exhibit superconductivity as resistance increases rapidly. A superconductor is one which conducts electricity with zero resistance to the flow of electrons.

"The data look interesting but whether they confirm superconductivity is not sure," observed Prof. Pratap Raychaudhuri from the Superconductivity Lab at the Tata Institute of Fundamental Research (TIFR), Mumbai. " The data is not unambiguous," he added.

> **The current-voltage characteristic was one of the important data that were not presented in the earlier paper.**
>
> ARINDAM GHOSH
> Department of Physics, IISc,

### Parallel results

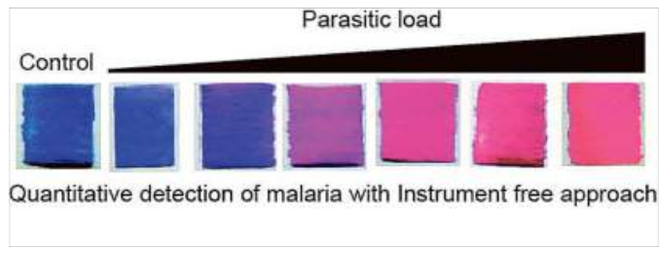
Referring to the figure on current-voltage characteristics, Prof. Raychaudhuri said that though the voltage increased sharply at about 10 milliampere critical current, the voltage was not zero before the sharp increase was seen. He compared the IISc work with another preprint posted by a team led by Prof. Subhankar Bedanta from the National Institute of Science Education and Research (NISER), Bhubaneshwar.

"The current-voltage characteristics [in Prof. Bedanta's preprint] show clear evidence of superconductivity," said Prof. Raychaudhuri. "At the critical current, the voltage is zero before it increases sharply."

Prof. Raychaudhuri added: "It would take more effort by the authors to convincingly show that the nanomaterial is indeed superconducting. The preprint posted earlier had very little data. Now, more data are available. Whether the data are correct or not can be settled only though scientific discourse – peer-reviewing and other groups reproducing it."

Clarifying about the zero voltage Prof. Ghosh said, "At temperatures slightly below 161.3 K the voltage is zero up to 10 milliampere current. The voltage may increase at higher current, which was not tested. Similar behaviour was observed in metal whiskers where superconductivity is observed at a lower temperature.

"At a lower temperature the voltage becomes zero. This further supports the original claim. The critical current data is a strong indicator of superconductivity," emphasised Prof. Ghosh. "We observed critical current behaviour which is one of the important characteristics of traditional superconductors."




**Colour change:** When the captured antigens interact with specific substrates inside the syringe, the blue dye turns into pink.

# New paper-based test kit for malaria detection

The team has applied for patents for one aptamer and the detection strategy used

ASWATHI PACHA

With over one million reported cases in 2017, malaria still continues to be a burden for India and most countries of southeast Asia. Now, a group of researchers from IIT Guwahati has developed a simple detection method that uses an instrument when in the lab or a piece of chromatographic paper when in the field.

The kit can be used to detect *Plasmodium* parasite, which causes malaria and also specifically detect *Plasmodium falciparum*, a notorious species.

### Simple instruments

Using an ordinary syringe fitted with a small magnet, magnetic beads and few chemicals inside, the researchers were able to specifically capture the antigen released by the parasites in the blood of malaria patients.

"As the blood has many interfering agents, we used magnetic bead-tethered aptamers (two small DNA molecules), which capture only the specific antigens and separate these from the blood serum to perform the reaction. The magnetic bead helps in holding the aptamers," explains Naveen Kumar Singh, Ph.D. scholar at the institute and first author of the paper published in *Analytical Chemistry*. "This kit also has high stability in hot and humid conditions. When mass produced, the kit can be cheaper than the existing rapid detection test kit available in the market."

One of the aptamers selectively captures the antigen (*P. falciparum* glutamate dehydrogenase - PfGDH) from the *P. falciparum* strains, while the other captures another antigen (*Plasmodium* lactate dehydrogenase - PLDH ) that is common to all the *Plasmodium* species.

The team used PfGDH instead of the currently used HRP-2 as there have been several reports of HRP-2 gene deletions in P. falciparum. This absence of gene allows the parasite to evade HRP-2-based detection tests, resulting in a false-negative test result.

When the captured antigens interact with specific substrates inside the syringe, the blue dye turns pink. The dye is then adsorbed over a modified chromatographic paper. The formation of pink colour on the paper is a direct indication of the presence of parasites in the blood serum. The intensity of the colour increases when the concentration of antigen is high.

"The paper-based method offers the result rapidly and the aptamer-tethered magnetic beads can be reused too." adds Naveen.

### Sensitivity

In the instrument-based method the intensity of the colour change is measured using a spectrophotometer. This gives a quantitative measurement and can detect very low level of the antigen in blood.

The team has already filed patent applications for one of the aptamers as well as for the detection strategy used to develop the kit. "The next phase of the work involves validation of the kit through field trial for point of care applications," says Prof. Pranab Goswami from the Department of Biosciences and Bioengineering at IIT Guwahati and the corresponding author.

# IIT Mandi observes zero resistance at high temperatures in gold-silver nanostructures

The group has fabricated structures that could be superconducting at relatively high temperatures

SHUBASHREE DESIKAN

New results from IIT Mandi indicate that nanostructures made of gold embedded with silver show zero resistance to the flow of electric current through them. Interestingly, this happens at the relatively high temperatures, between 240 K and 275 K, that is, approximately between -33 degrees Celsius and 2 degrees Celsius. "The resistance fluctuated as we lowered the temperature and suddenly fell below the limit of resolution of the apparatus on cooling below a critical temperature. As we repeated the heating and cooling, this critical temperature varied between 240 K and 275 K," says C.S. Yadav from School of Basic Sciences, IIT Mandi. This poses the interesting question of whether the group has fabricated structures that are superconducting at relatively high temperatures. A superconductor is a material that, for one, allows electricity to pass through it with zero resistance.

**Hopeful:** Effort is needed to dentify and stabilize the superconducting phase in these materials to pave the way for room temperature superconductivity, says Dr. Yadav. ▪ IIT MANDI

### Reproducibility

Though six gold-silver nanostructure samples were studied, the team was able to see such a fall in resistance only in one sample. They also did not observe the other important property of superconductors, namely, when a superconductor is cooled below the critical temperature in the presence of a magnetic field, it suddenly expels the magnetic flux from its insides below the critical temperature. This is because it turns into what is called a diamagnet at this temperature. A perfect diamagnet does not allow magnetic fields to penetrate its bulk.

The team was inspired by the work of Anshu Pandey and Dev Kumar Thapa of the Indian Institute of Science, Bengaluru, who had posted on ArXiv their observations on carefully fabricated nanostructures of silver embedded in gold. They observed a transition with resistance dipping to zero as the samples were cooled, and also a diamagnetic transition. Even as their preprint is under review, the IIT Mandi researchers bring to the public forum these observations on gold-silver nanostructures, albeit differently fabricated. "We started the work last year after the first report by Thapa et al," says Dr Yadav.

Viswanath Balakrishnan, from the School of Engineering at IIT Mandi, who led the study along with Dr. Yadav, explains the lack of diamagnetism as follows: "Our film was of thickness approximately 55 nanometre, so back-calculating, the amount of material must be just a few micrograms. It is very unlikely this can give a good signal of diamagnetism." He agrees that their plans include fabricating the nanostructure in bulk form: getting at least 1 square centimetre sample, get detailed characteristics and study the variations in microstructure. "The structure needs to be stabilised," he adds.

### Puzzling feature

The group also observed that the transition temperature was unaffected when they cooled the sample in very high magnetic fields, such as 14 tesla. "This is puzzling because normally the magnetic field is detrimental to the transition," says Dr. Yadav.

> **Our repeated measurements on this sample did show zero resistance transition over multiple cycles.**
>
> VISWANATH BALAKRISHNAN
> School of Engineering, IIT Mandi

As for the reason for observing zero resistance in only one sample, Dr. Balakrishnan explains, "We speculate this has to do with spatial inhomogeneity and instability issues associated with the particular phase. We could not observe this in other samples of same batch."

The reason for this, according to them, could be that microstructural and compositional distribution in the sample plays an important role in the transition. Dr. Balakrishnan adds, "Nevertheless our repeated measurements on this sample did show zero resistance transition over multiple cycles which are presented in our paper."

The researchers found that the control and stabilization of the correct phase of Au-Ag nanostructure present in thin film was the most challenging part of the work. But they are excited that their results will generate further interest in Au-Ag and other nanostructure systems in the quest for superconductivity at ambient conditions (that is, room temperature and normal pressure).

### Efforts needed

"Consistent efforts are required for the identification and stabilization of superconducting phase in these materials which will pave the way for room temperature superconductivity," says Dr. Yadav.

While there are questions, such as difficulty in reproducibility of the microstructure, it is undeniably an interesting phenomenon that the IIT Mandi researchers have come up with.

"We did not observe room temperature superconductivity but observed zero resistance in Au-Ag thin films. In the light of recent report from IISc, our study surely provides some evidence and strengthens the need for the further exploration in these systems," says Dr. Balakrishnan.

# Scientists create a global map of where groundwater meets oceans

PRESS TRUST OF INDIA

Scientists have created high-resolution maps of points around the globe where groundwater meets the oceans – the first such analysis of its kind that may help protect both drinking water and the seas.

In a study published in the journal *Geophysical Research Letters*, researchers from The Ohio State University in the U.S. showed that nearly one-half of fresh submarine groundwater discharge flows into the ocean near the tropics.

They also found that regions near active fault lines send greater volumes of groundwater into the ocean than regions that are tectonically stable.

They found that dry, arid regions have very little groundwater discharge, opening the limited groundwater supplies in those parts of the world to saltwater intrusion.

The team worked with researchers at NASA's Jet Propulsion Laboratory and the University of Saskatchewan to combine topographical data from satellites and climate models to show the flow of groundwater around the world's coasts.

**Aquifers:** Regions near active fault lines send greater volumes of groundwater into the ocean than tectonically stable ones. ▪ K. R. DEEPAK

### Managing freshwater

The findings may help coastal communities better protect and manage their drinking water.

"Freshwater-groundwater discharge is a natural line of defense against saltwater intrusion," said Audrey Sawyer, an assistant professor at Ohio State.

"It's a problem that dry regions have as little groundwater discharge as they do because these are also the places where people are going to tend to look for groundwater to meet their freshwater needs," said Dr. Sawyer.

The research work, the first near-global and spatially distributed high-resolution map of fresh groundwater flow to the coast, could give scientists better clues about where to monitor groundwater discharge.

When researchers think about coastal water quality and the way water affects the biochemical makeup of the world's lakes and oceans, they typically think about rivers and streams – and for good reason. Most of the water that gets to lakes and oceans comes from surface water sources. However, groundwater plays an important role, too, carrying minerals and, in some cases, pollutants, to surface bodies of water.

"If you've ever been swimming in a lake or in the ocean in the summertime and you go through a cold patch, that is probably a place where groundwater is coming out," Dr. Sawyer said.

"And that's just one way that groundwater affects surface water – in that case, it's affecting temperature, but it also affects the chemistry of the water. These effects can be hard to measure over large scales," he said.

The team started building these images. The research group focuses on groundwater, and realised that there was limited information showing where groundwater was most likely to flow into the oceans.

The study found that in some parts of the world, groundwater could be polluting oceans and lakes with nutrients and other chemicals.

Groundwater, for example, can carry higher concentrations of nitrates – a key contributor of the types of harmful algal blooms – as well as high concentrations of mercury.

Understanding how and where groundwater gets to surface water could help policy-makers create better plans to improve those bodies of water.

The study also found that climate heavily influences groundwater flow, and that cities in dry areas are especially vulnerable to salt water contamination of aquifers.