Surprise discovery for Indian scientists: nanosheets can also act as chemical reagents

Notebook:	office		
Created:	28-Nov-18 5:01 PM	**Updated:**	28-Nov-18 5:19 PM
URL:	https://www.downtoearth.org.in/news/science-technology/surprise-discovery-for-indian-scientists-nanosheets-c...		

Surprise discovery for Indian scientists: nanosheets can also act as chemical reagents

Team from IIT Gandhinagar discovers that boron-rich nanosheets are chemical reagents too, with potential applications in energy storage devices and next generation sensors

By Dinesh C Sharma

Last Updated: Tuesday 20 November 2018

Picture for representation only: Boron-rich nanosheets can function as nanoscale factories to manufacture nanoparticles by using metal ions as raw material. Credit: Getty Images

With extremely tiny materials — a millionth of a human hair — is allowing scientists to create new materials and think of innovative applications for them. A group of Indian scientists has developed a nanosheet which can also act like a chemical reducing agent. The discovery can have potential applications in energy storage devices and next generation sensors.

The research team at the Indian Institute of Technology, Gandhinagar, has found that boron-rich nanosheets, developed by them earlier this year, can also act as a chemical reagent.

During experiments, researchers noticed that boron nanosheets could remain afloat in water for long durations. The nanosheets, they found, remained afloat due to hydride groups borrowed from water. This observation led them to a new idea — using nanosheets in place of sodium borohydride, a popular reagent used to chemically reduce gold salt. When gold salt was introduced in dispersion of boron-rich nanosheets, it instantly reduced and formed gold nanoparticles onto nanosheets without the need of any external help.

They found that this can be extended to synthesize platinum and silver nanoparticles by dipping nanosheets in their respective salt solutions. This means boron-rich nanosheets can function as nanoscale factories to manufacture nanoparticles by using metal ions as raw material.

“The formation of nanohybrids with gold and graphene provides the proof of concept that the inherent reducing character of these nanosheets can be availed to create diverse mixed-dimensional heterostructures in solution,” researchers observed in their study in journal *Nanoscale*, published by the Royal Society of Chemistry. “Our initial experiments indicate that the noble metal nanoparticle-nanosheet hybrids are excellent electrocatalysts for hydrogen evolution reaction.”

Dr. Kabeer Jasuja, who led the research team, said “this is the first example of a nanosheet that is also a reducing agent, and presents a new perspective on the chemistry of nanosheets. Our work suggests that we can now design a wide range of boron-based nanohybrids in test tube. We have shown this capability by preparing a borophene-graphene like interface in solution. The concurrence of reducing nature and planarity makes these nanosheets an intriguing alternative over conventional reducing agents.”

"In essence, we have tamed down the otherwise reactive reducing agent borohydride by virtue of nanosheets. This means that now we have access to a mild reducing agent for selective reduction of electron rich organic moieties. This research has the potential to open up new avenues in organic synthesis that will be crucial for pharmaceutical and polymer industries,” added Dr. Arnab Dutta, a member of the research team.

The work was supported by seed funding from IIT Gandhinagar, INSPIRE Faculty Award Research Grant, and Core research Grant from the Department of Science and Technology. The team included Asha Liza James, Shikha Khandelwal, Dr. Arnab Dutta and Dr. Kabeer Jasuja.

(India Science Wire)

NEXT STORY

Science & Technology

Scientists look to mathematics to make cancer treatment more effective

The model-based treatment protocols will be based on accurate calculations, thus avoiding the preventable and uncomfortable side-effects of cancer treatment

By Monika Kundu Srivastava

Last Updated: Tuesday 20 November 2018

The researchers say the study opens up new avenues for further research in cancer treatment. Credit: Getty Images

Scientists at the Pune-based National Chemical Laboratory (NCL) of Council of Scientific and Industrial Research (CSIR) have developed a mathematical model that promises to deliver better protocols for cancer treatment.

The model has three main components—one for core tumour and other cells that subsequently get affected by cancer; the second for immune stimulators or boosters that help protect normal cells from getting affected; and the third for immune suppressors or dampeners that allow cancer to spread. The model describes most of the ways by which the three 'actors' could affect or influence each other.

It is expected to be of significance as treatment protocols could be developed based on accurate calculations, thus avoiding the preventable and uncomfortable side-effects of cancer treatment, researchers said.

A cancer tumour consists mainly of cancer stem cells (94.6 per cent), followed by cancer cells (4.5 per cent), resistant cancer cells (1 per cent) and drug-resistant stem cells (0.001 per cent). The stem cells, depending on the kind of stimulation received, are capable of changing into any type of cell and multiply rapidly. The spread of the disease can be limited significantly, if within 400 days of tumour detection cancer stem cells can be stopped from multiplying and resistant cancer cells stopped from changing into cancer stem cells and drug-resistant stem cells respectively.

After 400 days, when the cells multiply rapidly, it becomes difficult to treat. Many structural changes happen due to mutation, breakages and other factors, which can result in the cells becoming resistant to traditional drugs or radiation and treatment becomes ineffective.

Researchers tested two treatment protocols based on various interactions: one using only radiation and medication while the second included immunotherapy. They found that there was vast improvement in latter protocol in the form of a huge reduction in multiplication rate of tumour cells. This was because radiation had no effect on resistant stem cells, and chemotherapy impacted both stem and cancer resistant cells. Immunotherapy, on the other hand, was found to be beneficial both at early and later stages. In the early stage (till 400 days), it did not allow the number of resistant cells to increase and in later stages it did not allow the tumour to have its full effect due to an increase in the number of protective cells fighting cancer cells.

"The model can be used as a potential tool for the prediction of cancer prognosis and calculation of fold changes in the tumour subpopulations in response to a new treatment regimen. The study opens up new avenues for further research in cancer treatment," researchers said.

Commenting on the new model, Radhika Nair, Ramanujan Faculty Fellow at the Rajiv Gandhi Centre for Biotechnology, Thiruvananthapuram, said it was a novel study and the model could be applied to most cancers.

"The mathematical basis can help predict optimal drug dosage and treatment cycles which can have a huge benefit in avoiding unnecessary side effects of treatment. The model can also tell us how much intra-tumor heterogeneity as well as drug resistant cell population evolves in response to a new treatment regimen, that is, how the cancer might progress," Nair said. However, she said, while researchers have verified the model with known experimental data, it is essential to prove its clinical applicability as patients may have a unique manifestation of the disease.

The scientists – Piyali Ganguli and Ram Rup Sarkar of Chemical Engineering and Process Development Division at NCL - have published findings of their research in journal, *PLOS One*. The work was funded by the Science and Engineering Research Board (SERB). **(India Science Wire)**

NEXT STORY