



## **PRESS RELEASE**

### **IIT Mandi Research Team develops New Fluorescent Nanodots Markers to show Distribution of Water inside Biological Cells**

**Water distribution inside cells found to be different between Normal and Cancer cells, a development which could enable an alternative easy way of detecting Cancer Cells**

**MANDI, 25<sup>th</sup> April 2019:** An India Institute of Technology Mandi Research Team has shown using fluorescent nanodots how water is distributed inside biological cells. Their preliminary research indicates that the distribution of water inside normal cells is different from that inside cancerous cells, which, if understood better through future studies, could enable an alternative easy way of detecting cancer cells.

**Their research work was undertaken by a team lead by Dr. Chayan K. Nandi, Associate Professor, School of Basic Sciences, IIT Mandi and was recently published in the *Journal of Physical Chemistry C*.**

The human body is composed of trillions of cells, with their own specialized functions. Cells have multiple constituents, of which water amounts to 80%. Water molecules close to one another, are weakly attached to each other through feeble bonding forces called 'hydrogen bonds.'

The Hydrogen bonds are dynamic and change according to the interactions of water with the surroundings. The subtle changes in intracellular water, governing the cellular functionality, may initiate a series of biomacromolecular dysfunction that can lead to cancer or neurological disorders.

Markers are usually used to detect internal structures and components of cells. A 'marker' as name suggests, binds to specific components and shows their presence in some form; a fluorescent marker would emit light to show the presence and structure of the component to which it is attached. There have been, hitherto, no markers that can bond exclusively to water inside cells, thereby making fluorescence microscopy unsuitable for detection of intercellular water.

**Dr. Nandi's team at IIT Mandi has synthesized a fluorescent nanodot, a material that is in the scale of nanometres – about 80,000 times smaller than the width of human hair.** Dr. Nandi's nanodot is made of carbon and contains both hydrophilic (water loving) and hydrophobic (water hating) parts, much like a soap molecule. The presence of water repellent and water attracting parts within the same nanodot make them organise themselves according to the nature of the hydrogen bonding caused by the water molecules, like the formation of soap micelles around grease. In addition, the nanodot can fluoresce, i.e. emit light in the far ultraviolet wavelengths when illuminated with near ultraviolet light, and the time taken before it



fluoresces depends upon the micellar arrangement of the nanodots around the hydrogen bonding network.

By introducing these nanodots into cells, Dr. Nandi and his research team have shown that the hydrogen bonds and hence water contents are different in different parts of the cell. More important is the observation that the hydrogen bonding network is different in cancer and normal cells. Their work provides the first evidence that the nuclei of cancer cells contain more free water than normal cells.

**Speaking about the significance of this research, Dr. Nandi said,** “It has been difficult to understand and experimentally analyse the extent of hydrogen bonding in intercellular water. This is the first probe to provide direct evidence of the hydrogen bonding network in an entire cell.”

He added that given the difference in water distribution in different types of cells, future research would enable the utilization of these nanodots for detecting dysfunctional and diseased cells.

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**About IIT Mandi (<http://www.iitmandi.ac.in/>)**

Since the first batch of 97 students joined in July 2009, IIT Mandi has grown to host 1,300 students including 274 PhD, 46 MS and 17 I-Ph.D. research scholars, besides 110 Faculty and 150 staff. With 1.5 lakh sq.m. currently under construction, IIT Mandi has a fully residential campus, in Kamand. IIT Mandi has been ranked No. 20 in the Engineering Institutions Category in India Rankings 2019 released by National Institutional Ranking Framework, Ministry of Human Resources Development, Govt. of India (<https://www.nirfindia.org/>).

Since 2010, IIT Mandi's faculty has bagged nearly 180 projects worth more than Rs. 85 crore. A notable mention is the Advanced Materials Research Centre (AMRC), created in 2013 with an investment of about Rs. 50 crore, housing advanced instruments for characterization of materials. The Institute also hosts the 'Class 100 Clean Room' facility, a world-class research center that is first-of-its-kind in India. In 2017, Department of Biotechnology, Government of India, selected IIT Mandi to lead the prestigious Rs. 10 crore FarmerZone Project.

The unique, project-oriented B.Tech curriculum is centred on its 4-year long Design and Innovation stream. It is poised to become the first IIT to offer a B.Tech in Data Science & Engineering. There are many active MoUs with TU9 in Germany since May 2011. Several students from the Worcester Polytechnic Institute, U.S., have been visiting IIT Mandi every year since 2013.

Launched in 2016, IIT Mandi's Catalyst is the first Technology Business Incubator in Himachal Pradesh. EWOK (Enabling Women of Kamand Valley) is another innovative program run by IIT Mandi, which focuses on imparting Skills training to village-scale businesses by village women.

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