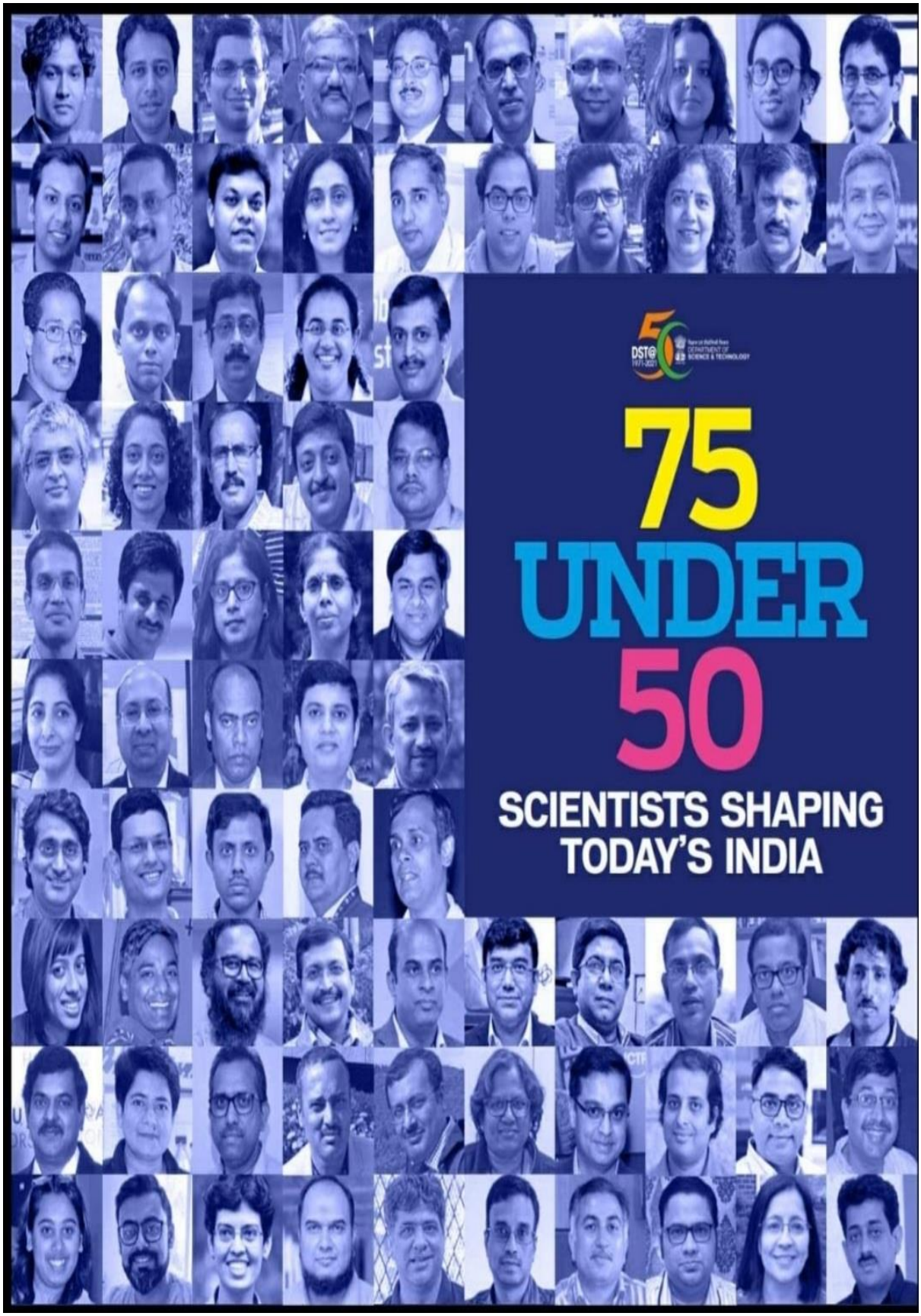
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DEPARTMENT OF SCIENCE & TECHNOLOGY
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SCIENTISTS SHAPING
TODAY'S INDIA

PROF. BIMAN B MANDAL

Sky Is the Limit

Drawn to the applicability of science to solve real-life problems led Prof. Biman B Mandal to research on lab-grown bioengineered tissues/organs as promising substitutes to save precious lives. One got a reflection of his inquisitive mind during his school days when, apart from science subjects, he preferred 'SUPW or Socially Useful Productive Work', where there was ample scope to nurture innate curiosity by making scientific models or creating useful things out of waste.

Prof. Mandal is a Professor at the Department of Biosciences and Bioengineering and Centre for Nanotechnology, IIT Guwahati and he also holds the Associate Dean, Academics (Undergraduate) position. Born in Purulia district of West Bengal, his father, Satyabrata Mandal, was in government service and mother, Shanti Rani Mandal, a homemaker. He graduated from Presidency College, Kolkata, and completed his master's from the Department of Biotechnology, HP University, Shimla. He obtained his PhD from IIT Kharagpur and postdoctorate from Department of Biomedical Engineering, Tufts University, Boston, USA.

The topic 'regenerative medicine and tissue engineering' which Prof. Mandal works on is a highly interdisciplinary translational research domain, which deals with body's ability to repair, heal and regenerate. The field has tremendous applicability being directly associated with human health, welfare and has the potential to contribute towards addressing an unmet world problem related to 'organ shortages'.

Acute shortage of matching organs and tissue donors have created a never-ending queue for patients and increased fatality rates. Except finding compatible donor's there is no current alternative to allow patients a healthy life. Thus bioengineered lab-grown organs could come a long way in saving millions of lives every year once successful.

> **"Trust your crazy ideas and keep working hard as sky is the limit."**

Research in this domain has made tremendous progress in a short span in understanding the cellular requirements to create such functional alternatives. However, current methods are not fullproof in fabricating whole organs or their large-scale affordable production. Further, the lab grown in-vitro tissues/organs can serve as disease model and as a great platform to study cell-material-cell interactions, emulate disease progression, help explore newer pathways aiding drug development. Innovative design parameters in mimicking native structures and choosing cell responsive yet low cost immune-compatible materials is considered essential to attain affordability, large-scale production and total functionality akin to the principle of 'form follows function'.

Prof. Mandal's laboratory at IIT Guwahati specifically focuses on recreating these functional tissues/organs using naturally derived silk biomaterials in combination with cells and added supportive factors using latest 3D bioprinting and other conventional techniques. The team also creates in vitro 3D disease models, for example, osteoarthritic, liver cirrhosis, cancer tumor as an alternative to existing animal models. Such in vitro model promises as a great platform to study cell-material-cell interactions, recapitulate human disease phenotype and emulate disease progression. In future, this would help explore newer pathways aiding

Clockwise L-R: Receiving the NASI-SCOPUS Award in Medicine

Receiving the NASI Young Scientist Medal from Prof. Manju Sharma

During his postdoc days

With his wife Dr Nandana Bhardwaj

With Prof. OP Sharma

With Prof Robert Langer of Massachusetts Institute of Technology

Below inset: With Prof. Nadrian Seeman, the father of DNA Nanotechnology

AWARDS

- Swarnajayanti Fellowship (2020)
- S. Ramachandran National Bioscience Award (2020)
- BM Birla Science Award (2018)
- INSA-Medal for Young Scientists (2015)
- NASI-Young Scientist Platinum Jubilee Award (2013)

PUBLICATIONS

- '3D printed silk-based biomimetic tri-layered meniscus for potential patient specific implantation'. *Biofabrication* (2020)
- 'Non-mulberry Silk Based Ink for Fabricating Mechanically Robust Cardiac Patches and Endothelialized Myocardium-on-a-chip Application'. *Advanced Functional Materials* (2020)
- 'Silk-based multilayered angle-plyannulus fibrosus construct to recapitulate form and function of the intervertebral disc'. *PNAS* (2018)
- 'Immunomodulatory injectable silk hydrogels maintaining functional islets and promoting anti-inflammatory M2 macrophage polarization'. *Biomaterials* (2018)

drug development and high throughput screening by pharmaceutical companies in a cost effective manner without harming animals.

To build a tissue or an organ in lab, Prof. Mandal uses a 3D platform or 'scaffold' for cells to grow on and organize in a controlled environment using specialized bioreactors. The protein silk scaffold being degradable gets broken down and used up as amino acids and subsequently replaced by cellular matrix secreted by own body cells as it matures. Without the 3D scaffold which fulfils certain parameters, cells alone cannot form a tissue in vitro. Prof. Mandal's lab is one of its kind in the country and internationally recognised for their work in the field of tissue engineering which uses natural bioresource 'silk' from Indian wild endemic varieties i.e. Tasar (A. mylitta), Muga (A. assama), Eri (P. ricini). The silk varieties have been proven to be superior with special cell binding RGD sites material properties making them ideal for such bioengineering applications. The groups published research articles have ushered a new global interest in Indian silk bioresource as a potential biomaterial apart from its known conventional use as a textile fiber and has been covered by BBC India, Scientific American and New Scientist.

As an outcome of their research endeavour at IITG, Prof. Mandal and his team could develop a number of affordable tissue engineered prototypes/ products which are in various phases of lab/animal validation. These include, smart wound dressings for treating chronic and diabetic foot ulcer wounds, small diameter blood vessels as graft for by-pass surgery, beating cardiac patch for treating myocardial infarction, bioartificial skin grafts for burn injury, implantable bioartificial pancreas releasing insulin for type-1 diabetes, intervertebral disc grafts for spinal injury, corneal grafts for vision restoration, meniscus grafts for knee injury, bioartificial liver devices for liver cirrhosis, bone and cartilage grafts for osteochondral repair, minimally invasive drug eluting injectable gels for targeted cancer therapy, lab-grown meat and in vitro disease models for drug-screening applications.

The group has published 145 highly cited high impact research articles in prestigious journals, filed 19 patents and licensed 3 technologies. Prof Mandal draws inspiration from his family, teachers and mentors, including Prof. SC Kundu (PhD) and Prof. David L Kaplan (Post Doc). No 'boundary of subjects' is the coolest thing in his research, he feels. •