

REVOLUTIONISING MANUFACTURING TECHNOLOGY

with 2D nanomaterials and 3D printing

After experiencing the pain of losing a loved one to lung cancer at the tender age of 10 years old, Assistant Professor Edison Ang from the Natural Sciences and Science Education (NSSE) Academic Group (AG) turned the emotional setback into an inspiration. It spurred him to complete his Doctor in Philosophy (PhD), and at the age of 33, he became an assistant professor at the National Institute of Education (NIE), an autonomous institute under the Nanyang Technological University (NTU), Singapore. This inspiration also led him to aspire to continually undertake high-level research and development, contribute to humanity, and nurture the next generation of youth. To this day, this belief has shaped his conviction towards research in order to empower teachers to inspire the next generation of young scientists and engineers whom he believed would bring about changes to the world.

As a researcher, Assistant Professor Ang is deeply interested in a wide range of nanoscale materials – particularly two-dimensional (2D) nanosheets that are 100,000 times thinner than the hair of human, and graphene, which can be found in pencil lead. “Understanding the properties of these nanomaterials has significant technological implications in energy conversion and storage, water purification, and food and beverage implementations,” quipped Assistant Professor Ang. His research activities include nanomaterial design and

fabrication, surface modification, coating, arrays and thin-film fabrications, defect engineering, 3D printed materials, developing sustainable materials, materials characterization, and device design.

I believe that the younger generation is humanity's greatest asset, and they are also the future of sustainability.

No matter how many times your proposal has been rejected, keep trying because nothing is possible unless you try, and if you try, there is still chance.

Upon learning that the National Additive Manufacturing Innovation Cluster (NAMIC), a national platform led by the Agency for Science, Technology & Research (A*STAR), saw the potential of 3D printing, and advanced materials in revolutionising current manufacturing processes and activities, Assistant Professor Ang decided to apply for the Rapid Concept Funding to support two of his research projects: 3D-Printing Membrane for Industrial Wastewater Treatment and 3D-Printed Electrode for High-Energy Rechargeable Batteries.

The aim of the first project was to develop 3D graphitic printed membrane proof-of-concept technology to improve the solvent permanence, dye rejection percentage, and reduce the energy usage of nanofiltration (NF) membrane. The aim of the second project, on the other hand, was to develop 3D graphitic printed cathode proof-of concept technology to improve the cycle life, the storage capacity, and charging rate of zinc-air batteries (ZABs).

In both projects, there was potential to commercialise these as high-performance NF membrane product and high-energy rechargeable product respectively, and to generate licensable IPs. This goes hand-in-hand with Singapore's National Research Foundation Research, Innovation and Enterprise (RIE) 2025 Plan to strengthen Singapore's positioning as a manufacturing hub and a Global-Asia node for technology, innovation, and enterprise. “3D printing technology is automated, scalable, and saves time and money in manufacturing,” explained Assistant Professor Ang. “We can print complex shapes without the use of a mould. We can also print multiple parts with precise dimensions in a single build with different design.”



Assistant Professor Ang Huixiang, Edison
Natural Sciences and Science Education Academic Group
Project title: Development of 3D Printed Graphene Ink for Energy Storage and Membrane Technology
Source of Funding: National Additive Manufacturing Innovation Cluster (NAMIC)

GRANTS AND RESEARCH ADVANCEMENT

However, such technologies are not without challenges. One of the major challenges of implementing nanomaterials for rechargeable batteries and membrane filtration applications is the lack of structural design and controllable dimension. According to Assistant Professor Ang, this limits their optimum and consistent performance for practical application. “The advancement of 3D printing technology has revolutionised the customization of functional materials. However, we must not lose sight of the importance of remaining sustainable while doing so.” cautioned Assistant Professor Ang.

Reflecting upon his research journey in 2D nanomaterials, Assistant Professor Ang shared that in 2020, he started Nanotech Lab and had since developed a unique 2D nanomaterials ink (graphene), which can be 3D printed, paving the way for new industrial opportunities in the fields of rechargeable batteries and membrane filtering. Extending his gratitude to the support he had received from his collaborators, NAMIC and Singapore Centre for 3D Printing, Assistant Professor Ang added, “These amazing works have resulted in two provisional patents.”

Following these achievements, Assistant Professor Ang was awarded Outstanding Asian Science Diplomat Award and Vebleo Fellow Award in 2021 in recognition of his outstanding research work and leadership in the field of science, engineering and technology. In 2022, he was invited by the International Association of Advanced Materials to give a Young Scientist Medal Lecture on “Chemistry of Two-Dimensional Nanomaterials for Energy Storage and Membrane Technology” to showcase his 3D printed works. As a young faculty member, he was also elected by the prestigious publishers, for instance, Elsevier, as an Early Career Editorial Board Member of Chemical Engineering Journal and Springer Nature, as a Young Editorial Board Member of Journal of Leather Science and Engineering.

To fellow researchers and faculty members who may be looking out for grants and funding to support their research work, Assistant Professor Ang has this to share, “No matter how many times your proposal has been rejected, keep trying because nothing is possible unless you try, and if you try, there is still chance.”

To find out more about research grants and funding, visit www.nie.edu.sg/gpl/rgm or “GPL-Managed Grants” via NIE Staff Portal.