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EDITORIAL

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Nanoscale Horizons Emerging Investigator Series: Dr Pengzhan Sun, University of Macau, China

Our Emerging Investigator Series features exceptional work by early-career nanoscience and nanotechnology researchers. Read Pengzhan Sun's Emerging Investigator Series article 'Catalytic selectivity of nanorippled graphene' (**https://doi.org/10.1039/D3NH00462G**) and read more about him in the interview below.

Dr Pengzhan Sun is an assistant professor at the Institute of Applied Physics and Materials Engineering, University of Macau. He obtained his Bachelor's degree in mechanical engineering and automation (2012) and PhD in materials science and engineering (2016), from Tsinghua University. From 2016 to 2022, he was a research associate working at the Department of Physics and Astronomy and National Graphene Institute (NGI) at the University of Manchester. His research interests include the fundamental understanding of molecular transport under confinement, the synthesis and processing of 2D crystals building blocks and their rationally designed assemblies for emerging technologies in the environment, energy, informatics, *etc.* He has published many papers as first/corresponding author in journals including *Nature*, *PNAS*, *Nature Communications*, *Science Advances*, *Nanoscale Horizons*, *etc.* Also, he has been awarded important prizes including the MIT Technology Review 35 Innovators Under 35 (China), Materials Research Society (MRS, USA) Graduate Student Award (Silver), NSFC Excellent Young Scientist Fund, *etc.*

Read Pengzhan Sun's Emerging Investigator Series article 'Catalytic selectivity of nanorippled graphene' (**https://doi.org/10.1039/D3NH00462G*****) and read more about him in the interview below:***

NH: *Your recent Nanoscale Horizons Communication investigates the catalytic selectivity of nanorippled graphene, showing that it exhibits high selectivity towards different reactions involving hydrogen. How has your research evolved from your first article to this most recent article and where do you see your research going in future?*

PS: Since I started my PhD career in 2012, my research has mainly focused on the experimental understanding of molecular and ionic transport under strong confinement, which is constructed by the assembly of 2D crystals. My first article was published in 2013, in the first year of my PhD, which dealt with selective ion permeation through a lamellar membrane stacked and overlapped by monolayer graphene oxide sheets. Although nice experimental results were obtained regarding the selectivity of fabricated membranes toward different ions, a rather fundamental question arose in my mind, that is, how permeable is the impermeable graphene lattice? After completing my PhD, I moved to the University of Manchester and worked with Prof. Sir Andre Geim dealing with this question. Then we published a *Nature* paper in 2020 showing that molecular hydrogen could unexpectedly permeate through graphene, whereas the smaller and generally much more permeable helium atoms cannot. The mechanism for the anomalous hydrogen transport involves dissociation of molecular hydrogen on the nanoripples of graphene, resulting in hydrogen adatoms/protons, followed by the flipping of the latter across graphene's lattice. The hydrogen dissociation step emphasized the unexpected catalytic activity of nanorippled graphene. Later we corroborated this strong catalytic activity using experiments and provided a new degree of freedom for tuning 2D materials' catalytic properties, *via* introduction of nanoscale non-flatness. In the present published paper (*Nanoscale Horiz.*, 2024, **9**, 449–455), we have moved a step forward in this research area and shown that in addition to the high catalytic activity, nanorippled graphene exhibits excellent catalytic selectivity toward reactions involving hydrogen.

In the future, this work can be readily extended by measuring the catalytic activity and selectivity toward a wider range of reactions and, also, by exploring the possibility of hydrogen storage using confined space in, for example, the interlayer spacing of layered crystals using mixed powder containing monolayer (for catalytic hydrogen dissociation) and multilayer graphene (for storage of dissociated hydrogen adatoms).

NH: How do you feel about Nanoscale Horizons as a place to publish research on this topic?

PS: *Nanoscale Horizons* is a leading journal for the publication of exceptionally high-quality, innovative nanoscience and nanotechnology. One of its unique aspects is that the journal places an emphasis on original research that demonstrates a new concept or a new way of thinking. Our published topic emphasizes a new concept of strong and selective catalytic reactivity of nanorippled graphene, which is conceptionally new and different from flat graphene and graphite. This unexpected property has not been reported before and I believe *Nanoscale Horizons* was the ideal place for this new concept.

NH: What aspect of your work are you most excited about at the moment?

PS: One of the most exciting aspects of this work is that all our samples (monolayer graphene powder) used for the study were purchased directly from commercial suppliers without further purification or treatment. The monolayer graphene powder can be prepared on a large scale. This provides strong potential for extending our lab-scale experiments to industrial-scale applications.

NH: In your opinion, what are the most important questions to be asked/answered in this field of research?

PS: Personally speaking, I think two questions remain to be answered in this research field. First, how to control the number density and curvature of nanoripples in graphene membranes, so that the catalytic activity/selectivity could be predicted and tuned? And secondly, how to achieve rapid adsorption/desorption of the dissociated hydrogen atoms so that a new hydrogen storage system could be developed based on nanorippled graphene and other materials having confinement space, such as layered crystals, MOFs, COFs, *etc.*

NH: What do you find most challenging about your research?

PS: My current research heavily involves microdevice fabrication, aiming to create a relatively simple and explainable system for directly studying molecular transport under precisely designed extreme confinement and the associated reactions on the surface or in the confinement space. However, extending the exciting results observed at the microscale to the macroscale presents a challenge because unpredictable factors could arise when fabricating macroscopic samples using microscopic building blocks, which could possibly submerge observations at the microscale.

NH: In which upcoming conferences or events may our readers meet you?

PS: I am more than happy to meet our peers and readers in upcoming conferences such as events held by the Royal Society of Chemistry and other conferences such as the Beijing Graphene Forum 2024, Graphene Week 2025 and the MRS spring and fall meetings.

NH: How do you spend your spare time?

PS: In my spare time, I like to do sports (*e.g.*, cycling and going to the gym), listen to music, visit galleries and museums, and I enjoy theatre arts and read books.

NH: Can you share one piece of career-related advice or wisdom with other early career scientists?

PS: I would like to share wisdom similar to the aim of *Nanoscale Horizons*, that is, try to be different, rather than better.

