

## 2023 King Faisal International Prize for Science and Medicine

The King Faisal Foundation in Riyadh, Saudi Arabia, has awarded the 2023 King Faisal International Prize for Medicine (topic: Pandemics and Vaccine Development) to Dan Hung Barouch and Sarah Catherine Gilbert. The Science Prize in the field of chemistry has been awarded to Jackie Yi-Ru Ying and Chad Alexander Mirkin. The Prize comprises a 24-carat gold medal weighing 200 g and a cash award of 750 thousand Saudi Riyal (USD 200,000).

The Prize for Medicine covering the field of pandemics and vaccine development is timely. Viral infections have historically endangered humanity with new outbreaks and resurgences. In order to deal with the COVID-19 pandemic, it has been helpful to examine the vaccine techniques and technological platforms utilized to combat prior, developing, and reemerging infectious diseases and pandemics.

Barouch was born in 1973 in Gottingen, Germany. He is the William Bosworth Castle Professor of Medicine at the Harvard Medical School, Boston, Massachusetts, USA. Since 2012, he has been serving as the Founding Director of the Center for Virology and Vaccine Research at Beth Israel Deaconess Medical Center in Boston. Barouch and colleagues successfully developed a set of ‘mosaic’ proteins (a protein that is made up of different domains, giving it multiple functions), improving immune responses against multiple virus strains<sup>1</sup>. His techniques enabled the development of the COVID-19 vaccination by the American company Johnson & Johnson<sup>2</sup>. Hundreds of millions of individuals around the world have received this vaccine. Barouch has been awarded the Prize in recognition of his ‘major contribution to our understanding of the immunology and pathogenesis of viral infections. He has developed novel vaccine and treatment strategies against multiple pathogens of global significance, including HIV-1, Zika virus, tuberculosis, and most recently SARS-CoV-2’.

Gilbert was born in 1962 in Kettering, UK. She is a Professor of vaccinology at the University of Oxford, UK. Since 2021, she has held the Saïd Chair of Vaccinology and is Head of the Outbreak Pathogens Vaccine Group in the Pandemic Sciences Institute of the Nuffield Department of Medicine at the University of Oxford. Her main area of research is the development of viral vectored vaccines that work by in-

ducing strong and protective T- and B-cell responses. Her approach emphasizes the preclinical and clinical assessment of vaccines produced using viral vector platform technologies. At the beginning of the COVID-19 pandemic, Gilbert produced a vaccine that worked well on monkeys<sup>3</sup>. This success was followed by additional animal trials and, subsequently, human trials, eventually leading to the development of a vaccine against SARS-CoV-2. This vaccine was licensed to the British–Swedish company Astra Zeneca and has been distributed in 180 countries. Gilbert has chronicled a lucid account of vaccine development in her book<sup>4</sup>. She has been awarded the Prize for ‘developing innovative vaccine technologies and applying them to malaria, Ebola, influenza, MERS and lately SARS-CoV2. This latter vaccine has achieved a wide geographical distribution due to its effectiveness and low cost, making it accessible to billions of people. It has greatly participated in vaccine equity worldwide’.

Ying was born in 1966 in Taipei, Taiwan. She obtained her Ph.D. in chemical engineering from Princeton University, USA. She is now leading her own laboratory, the NanoBio Lab (<https://www.jyyinglab.net/>), after holding several prestigious positions, including Executive Director, Institute of Bioengineering and Nanotechnology, Singapore (2003–18) and Professor, Department of Chemical Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts, USA (2001–05). Her laboratory has developed nanocomposites, nanoporous materials and nanodevices with unique size-dependent characteristics. These novel systems have a wide range of applications in catalysis, energy conversion and biomedicine<sup>5,6</sup>. Ying has developed stimuli-responsive polymeric nanoparticles that deliver insulin to diabetic patients only when their blood glucose levels are high, without resorting to external blood glucose monitoring. This achievement was recognized in 2015 by the inaugural Mustafa Prize for Science from Iran<sup>7</sup>.

Mirkin was born in 1963 in Phoenix, Arizona, USA. He is the founding Director of the International Institute for Nanotechnology and the Rathmann Professor of Chemistry and Professor of Medicine, Materials Science and Engineering, Biomedical Engineering, and Chemical and Biological Engineering at Northwestern University,

Illinois, USA. Mirkin’s group is credited with the invention of the spherical nucleic acids (SNAs), which are nanostructures that consist of a densely packed, highly oriented arrangement of linear nucleic acids in a three-dimensional, spherical geometry<sup>8</sup>. SNAs are employed for the synthesis of novel materials used for making high-sensitivity probes for chemical and medical diagnostic purposes. Using the SNA–gold nanoparticle conjugates, Mirkin introduced the concept of a nanoparticle as an ‘atom’ and nucleic acids as ‘bonds’, and thus laid the foundation for the fields of colloidal crystal engineering with DNA and molecular diagnostics<sup>9</sup>. He also invented scanning probe lithography-based tools for synthesizing novel surface-based nanostructures. Such nanostructures are finding numerous applications in the discovery of new materials and cellular analysis<sup>10</sup>.

For the year 2024, the topic for the Medicine Prize is ‘Management of Peripheral Disabilities’, and the Science Prize will be in the field of biology (see <http://kingfaisalprize.org/>).

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**Sameen Ahmed Khan**, Dhofar University, Department of Mathematics and Sciences, College of Arts and Applied Sciences, Salalah, Sultanate of Oman.  
e-mail: rohelakhan@yahoo.com