Ben L. Feringa

Ben L. Feringa is a Dutch synthetic organic chemist whose research interest includes stereochemistry, organic synthesis, asymmetric catalysis, molecular switches and motors, self-assembly, molecular nanosystems and photopharmacology. He obtained his Ph D degree from the University of Groningen in the Netherlands under the guidance of Prof. Hans Wynberg. After his stint as a research scientist at Shell in the Netherlands and the UK, he was appointed lecturer and became full professor in 1988 at the University of Groningen; he was also named the Jacobus H. van't Hoff Distinguished Professor of Molecular Sciences in 2004. He was elected Foreign Honorary member of the American Academy of Arts and Sciences. He is a member of the Royal Netherlands Academy of Sciences as well as a member of the Council of the Royal Society of Chemistry. In 2008, he was appointed Academy Professor of the Royal Netherlands Academy of Sciences and was knighted by Her Majesty, Queen of the Netherlands.

Feringa's research has been recognized with numerous awards, including the Körber European Science Award (2003), the Spinoza Award (2004), the Prelog Gold Medal (2005), the Norrish Award of the ACS (2007), the Paracelsus Medal (2008), the Chirality Medal (2009), the RSC Organic Stereochemistry Award (2011), the Humboldt Award (2012), the Nagoya Gold Medal (2013), the ACS Cope Scholar Award (2015), the Chemistry for the Future Solvay Prize (2015), the August Wilhelm von Hoffman Gold Medal (2016), the 2016 Nobel Prize in Chemistry, the Tetrahedron Prize (2017) and the European Chemistry Gold Medal (2018).

The following is an interview with Feringa during his visit to India in March 2019, as the Raman Chair Professor of the Indian Academy of Sciences, Bengaluru.

How did you become interested in synthetic chemistry?

I grew up on a farm in a very small, remote village in the Netherlands. Growing up with nine siblings on a farm amidst nature provided a good playground for discovery. This is what got me very enthusiastic as a child. Later, during my high-school years, I liked chemistry a lot owing to a good chemistry teacher who carried out experiments with us and explained why chemistry was important. I will always remain grateful to all my teachers. Though I excelled in mathematics, I chose chemistry at the university level. During that time, I was one of the few people from our village to attend university. I was offered a scholarship from the government owing to which I could study at the university. When I was 19 years old, I developed a new molecule; I still remember that the American professor, who I worked with, remarked that the molecule that I had developed had never been made by anybody in the world. Though the molecule didn't have much use, it felt good that I could create my own molecular world. That is the beauty of synthetic chemistry – the fact that you can create or make things. The field requires creativity, imagination and taking advantage of all possibilities, and that is what appeals to me.

What opportunity does synthetic chemistry open up for society and industry going forward?

When you look around, the materials we use, be it a smartphone, clothes, drugs, fuels, and so on, are due to the possibilities of chemistry together with other branches of science. Society has benefited tremendously from the developments in science over the past hundred years. For example, 40% of us would not be here if we didn't have drugs. Hence continuous development is required. However, during the course of development, we also need to address bigger challenges such as: How are we going to feed 10 billion people? How are we going to travel in future? How are we going to recycle or reuse materials? It is our duty to develop new technologies that are cleaner, cheaper and energy-efficient. However, chemists cannot work in isolation; we need to work together with other branches of science for a sustainable society of the future. It is important to invest in educating and enthusing young people on these aspects, because they will shape the future. Science has no borders and is all over the world. We together need to discuss and come up with good ideas to make a better world and determine the way forward. Universities, research institutes and academies of science have a crucial role to play in this.

Can you talk about the work in green chemistry in your group?

We work in the area of catalysis to design new catalysts for chemical reactions. For example, with these new catalysts, reactions for 24 h at 80°C can be done in 1 min at room temperature or even lower temperatures, without the use of harmful solvents. Thus reactions can be carried out using less energy and material, with less waste and low toxicity. We also work on photochemistry and electrochemistry that have a lot of potential for the future. Sunlight or energy-efficient LED lamps are used in photochemical reactions. Also, since electricity is becoming inexpensive owing to solar panels, wind energy, etc. it can be used instead of heat in chemical reactions. On-going projects with industry in these areas provide students a good flavour of moving from fundamental discovery in the laboratory to industrial processes. However, the challenge ahead is to come up with sustainable processes that cater to a growing population.

Can you talk about some of the work in the area of biohybrid systems?

We have not been working on biohybrid systems for a very long time. About 8–9

years ago, we conceived the idea of smart pharmaceuticals. We built the switch into a drug that could be activated or deactivated by turning the switch on/off. The switch is turned on by irradiation, which in turn activates the drug and provides precise therapy. This is still a long way to the clinic, but works well. The other area we work on is imaging such as X-ray, PET using radio isotopes and fluorescence imaging. We work with hospitals to build new technology in imaging to find small tumours or disease spots like an infection.

Do you see a timeframe when smart drugs are likely to be commercialized?

That is always difficult to say as the university is primarily focused on fundamental research. A new pharmaceutical takes several years and a lot of money to develop owing to clinical studies. Only one in many compounds makes it, while several fail. At the university we file patents for good ideas and negotiate with companies to work together. Also, two students from my group have a start-up company to make smart drugs. Some of these small start-ups are likely to become big companies in the future. I would urge young people to venture into such avenues more often.

With regard to the on-going research in your group, what are you excited about?

I am passionate about several things. At the moment I am excited about the possibilities of smart drugs. I am also enthusiastic about the work in catalysis, as it is important for our industries to develop sustainable processes. If asked what I would love to discover, it is the answer to question 'Where are we from?' How did water and other molecules come together to build something as complex as a living cell? What intrigues me most is that a crucial aspect of life is asymmetry. Everything in the human body is asymmetric – right-handed DNAs, left-handed amino acids, and so on. Asymmetry is the signature of life. Perfect symmetry inside the body would mean no life. Nobody knows where the asymmetry comes from; there are many theories, but nobody knows. The origin of life is directly connected to the origin of asymmetry of the building blocks of DNA. I would love to solve such a fundamental question.

What is your message for students aspiring to be scientist in your field?

The best part of chemistry is that you can design materials from scratch and the possibilities are endless. There are still many molecules to make and materials to discover. My most important message is to follow your dreams while taking advantage of your talent. Not everybody may become a scientist, but each one of us has a unique talent that we can use to our advantage. Science has a lot to offer; but to become a scientist, you have to be able to stand uncertainty and take risks. Value the joy of learning and discovering, and do not be afraid.

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