



Nanotechnology: Applications and Opportunities

Recognizing the pioneering role of Sultan Qaboos University (SQU) in the Sultanate's higher education sector as the most prominent institution for teaching, research and community service, the first Chair of Oman's Research Council (TRC) was granted to SQU in order to meet the increasingly changing needs of development in the Sultanate and leverage the existing and future capacity in Nanotechnology, with a special focus on Water Desalination.

Activities of the TRC Chair in Nanotechnology at SQU include, research and development focused on the application of nanoparticles, nanomaterials and desalination processes. The chair strives for innovative research suited to the region, education and training of highly qualified personnel and in increasing public and industrial awareness of nanotechnology, amongst others. According to Prof. Joydeep Dutta, Chair in Nanotechnology for Water Desalination, the research group is involved in developing applications that address the needs of those who are without –clean drinking water, cheap energy, unspoiled food, and the other necessities required to provide for a decent living. The Chair is focusing on dedicated research and development issues addressing water desalination-both of seawater as well as brackish water.

A state-of-the-art laboratory of the Chair, containing wet-chemistry facilities, Analytical equipment room and electronics bench has been built in a single workspace at the College of Engineering premises. At present, a few broad themes for research were identified in consultation with the technical committee and work is continuing along these themes. The research themes are "Designer metal-oxide nanostructures", "Capacitive desalination with functionalized nanostructures", "Condensation induced renewable desalting", and "Functionalized micro or nano membranes". The unifying concept in the laboratory is to make use of inexpensive wet-chemical methods to fabricate innovative materials and futuristic device components with an eye on its application in water desalination and water treatment.

Potential applications research

Prof. Dutta said that nanotechnology-based research, education and training program at SQU will be focused towards developing nanomaterials for applications ranging from water desalination and purification, to energy and environment. "Our research group will attempt to address some of these aspects of creating knowledge in niche areas relevant to Oman and the region and develop a knowledgeable workforce for future development of Nanotechnology in local industries and finally the society to benefit from", he said. In this research group, emphasis is given to application of nanotechnology to water desalination. However, it is envisioned that initial activities will lead to the creation of a National Center of Excellence in Nanotechnology in Oman, towards which other universities and research Institutes in Oman will contribute. The Chair is focusing on conducting research to develop different nanomaterials for application in water desalination through advanced membranes and other means to decrease the cost and increase efficiency of desalting. The Chair will also strive to develop nanotechnology education in Oman.

"The Chair will certainly pave way for better understanding among vari-

ous research groups in the University, Oman and the gulf countries working in the areas related to purification of water. The project aims at reducing any knowledge gap and introducing new technologies to face the ever changing topics in the growing field of nanosciences. There is a strong need to develop coercive curriculum for undergraduates and graduate level courses to equip future scientists, engineers and business people alike, to address issues related to the commercialization of nanotechnology", Prof. Dutta said. These are the stated goals of the TRC Chair in Nanotechnology at SQU. Prof. Dutta and his team have an extensive list of research publications in their credit. After joining as Chair in Nanotechnology at SQU in 2011, the team led by Prof. Dutta published as many as 45 research papers in reputed international journals. The number of citations since 2008 is 2065.

Anti-fouling Research

Dr. Sergey Dobretsov, Associate Professor in the Department of Marine Sciences & Fisheries of the College of Agricultural & Marine Sciences at SQU, said that nanotechnology opens a new way to prevent bio-fouling (undesirable growth of organisms on submerged surfaces) in the industrial applications. "Nowadays bio-fouling is treated with highly toxic compounds that harm the environment and accumulate in marine organisms. In some industrial applications, like water treatment and desalination plants, it is not possible to use these compounds. In comparison, nano-coatings are less toxic and provide protection by chemical and physical surface modifications at nano-level", he said. Dr. Dobretsov has been testing novel nano-coatings developed by the group of Prof. Joydeep Dutta. "Cooperation with Prof. Dutta, Chair in Nanotechnology for Water Desalination, and his group was fruitful and many new discoveries are under way", Dr. Dobretsov said.

Dr. Nabeel Al Rawahi, Head of the Department of Mechanical & Industrial Engineering at SQU, said that his association and with the TRC Chair of Nanotechnology for Desalination at SQU started very early in the proposal stage to start the Chair as a member in the joint committee between the College of Engineering and the College of Science. "It continued during the period when the university had been searching for the right person to take the responsibilities of the Chair. Since Prof. Dutta has been assigned as the Chair, I have been a member in the technical scientific committee of the Chair. Currently, I am involved in the Desalination related projects associated with Chair. This includes 'condensation induced renewable desalting' and studies on nano-fluids".

Commenting on his involvement with the TRC Chair, Dr. Mohammed Al Abri, from the Department of Petroleum & Chemical Engineering said: "I am interested in desalination of water and naturally Prof. Dutta's arrival was very interesting news for me. I am involved with the nanotechnology research developing new types of membranes and have jointly taken PhD students working on water desalination and water treatment. I believe that the introduction of nanotechnology in Oman is appropriate and we can strive to take a leadership position in the water desalination areas creating state-of-the-art processes and techniques".