The Business Times, Tuesday, 3 Nov 2015, page 15

# Project seeks to develop more effective marine coatings

**By Narendra Aggarwal**

FORTY-YEAR-OLD Assistant Professor Ali Miserez comes from Switzerland, a country with no maritime shores. A faculty member at Nanyang Technological University's School of Materials Science and Engineering, and School of Biological Sciences, he is deeply involved in maritime research.

After his PhD, when he was a post-doctoral researcher at the University of California in Santa Barbara, his interest in marine science and marine biotechnology sparked.

"I wanted to conduct research in an environment where I could work on similar topics and where I could find strong R&D infrastructures. This is how I ended up moving to Singapore," says Dr Miserez.

The overall focus of his research group programme is on bioinspired materials and biomimetics. "In short, we are taking inspiration from living organisms that produce unique structures, with properties that are unmatched in synthetic materials. Many of our inspirations come from marine organisms, such as squids, sea cucumbers, or the mantis shrimps," he says.

Dr Miserez's project on development of adhesive mimics for anti-fouling coatings and adhesion testing in the marine environment was selected as one of the top three projects under the Singapore Maritime Institute's (SMI) Research Showcase in October 2015.

This project emerged ahead of other maritime projects in terms of innovation in research approach and the potential impact of research outcomes applied in the maritime industry. Seen as a "reverse engineering approach" towards a focused study on the adhesive properties of the bio-organisms, it will greatly benefit the maritime industry where the focus has typically been the properties of anti-fouling coatings (paint).

Biofouling is the attachment of micro and macro-organisms (such as barnacles, algae or mussels) on underwater structures such as ship hulls and port infrastructures. It is a major challenge for the maritime sector and is an issue on multiple fronts.

It increases the weight and friction of boats, which leads to increased fuel consumption. This is estimated to add up to S$40 billion every year to the global shipping industry's cost. In addition, it creates ecological burden. First, the extra fuel consumption leads to additional greenhouse emissions, thus contributing to global warming. And second, it leads to the carrying of invasive species in their non-native environments, which eventually seriously affects the ecological balance of these environments.

**"Our aim is to understand how organisms stick to solid structures at the molecular scale, namely we aim to identify the chemical molecules involved in the sticking process and their modes of actions," says Dr Miserez.**

"Our project tackles this issue of biofouling. Our aim is to understand how organisms stick to solid structures at the molecular scale, namely we aim to identify the chemical molecules involved in the sticking process and their modes of actions. Most of these molecules are 'gluing' proteins secreted by the organisms," says Dr Miserez.

To reach this goal he is using advanced genetic sequencing methods, which are used to obtain the genetic signature of the cells that make these proteins. In parallel, he is using biochemistry to fully identify these "gluing" proteins from the fouling organisms. Eventually, his team is artificially making these glues in the lab using genetic and protein engineering. These artificial glues can then be tested against any type of coatings to see how they stick against the coatings.

"Ideally, one would want to make coatings that prevent the sticking of these adhesive glues," says Dr Miserez. At the moment, the development of anti-fouling coatings takes very long and one major reason is the time factor in testing the anti-fouling performance of such coatings. Typically, newly developed coatings are tested in the sea for months and even years to determine their efficiency.

"With our project, we aim at providing assays that will lead to a quicker turnaround to determine whether a new type of anti-fouling coating is performing well or not. We are also using methods that are physically more realistic, while the current methods of checking anti-fouling potential are rather empirical," says Dr Miserez.

His research group, the Biomimetic and Bioinspired Materials Laboratory, affiliated with the School of Materials Science and Engineering and the School of Biological Sciences at NTU, is leading the project. The team is working closely with Dr Shawn Hoon, a senior research fellow at A*STAR's Molecular Engineering Laboratory.

For this specific research project, SMI is providing the funding for three years. Previously, this research was initiated with another grant from the Maritime and Port Authority of Singapore (MPA), which was awarded in 2010 and lasted until 2013.

Dr Miserez says that industry partners are involved in the research.