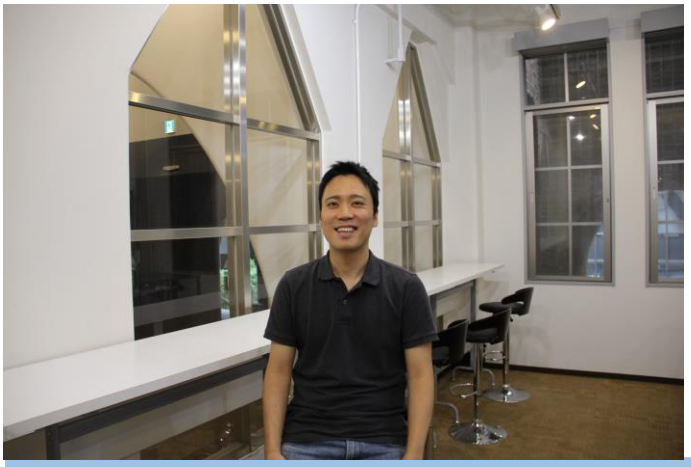
Department of Materials Engineering
Associate Professor Hirotaka Ejima



[CV]
Dec.2016 – present
Associate Professor, Department of Materials Engineering,
The University of Tokyo

2011
Ph.D., (Chemistry & Biotechnology), Graduate School of Engineering,
The University of Tokyo

[motto]

"Live life in such a way that you feel you moved in the best direction."

These are words from Makoto Fujita, Professor at the University of Tokyo's Department of Applied Chemistry. A lot of the choices we make in life don't have the results we expect, but I think we can live fulfilling lives by thinking positively and giving our best effort, no matter the circumstances.

Creating New Materials by Learning from Organisms

I have three primary research focuses. The first is self-healing polymers. When living things are damaged, they are able to heal naturally. If artificial materials were able to self-repair in the same way, it would be useful. My second research focus is underwater adhesive polymers. Though adhesives are widely used today, they often fail to stick in wet environments. To address this problem, we take inspiration from shellfish (which adhere firmly to rocks in the sea). We work to imitate the structures of these organisms to help us develop adhesive materials that work well underwater. My third research focus is cell coating. There's a type of unicellular organism that creates a shell around itself and begins hibernating if exposed to stress such as UV rays or dry conditions. When favorable conditions return, the organism breaks down the shell and begins growing. We are researching whether it's possible to create shells like these artificially.

Environmental and Medical Applications

A recent news topic was the banning of plastic straws in cafes and restaurants. This ban was enacted because micro-plastics—tiny fragments of waste plastic—cause marine pollution. If self-healing polymers were available, however, plastics would have longer lifespans and would be more difficult to break down (meaning they would not deteriorate into tiny fragments). I believe that this technology can contribute to making sustainable societies.

I also think about the medical applications of adhesive polymers intended for underwater use. For example, there are times when medical professionals would like to use adhesives to repair cuts in skin or internal organs. The inside of the human body is wet, similar to underwater environments. We aim to develop adhesives that can be used to address these conditions.

Cell coating would enable us to transport cells such as iPS cells while preserving their qualities. I believe this could contribute to developments in regenerative medicine.

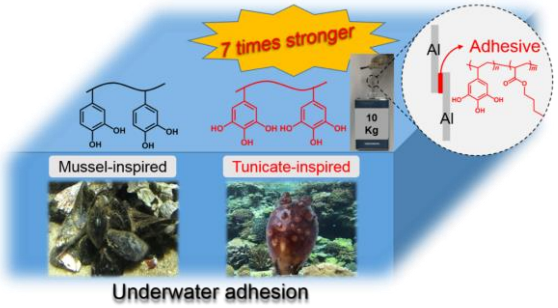


Fig. Underwater adhesive took inspiration from marine life

Pursuing my Uniqueness

When I was an undergraduate student at the Department of Chemistry in the School of Science, I researched GFP (green fluorescent protein) cell imaging. Professor Osamu Shimomura was awarded the Nobel Prize for his work in this field. The professor in the laboratory I belonged to retired, so for my master's I moved to the Department of Chemistry & Biotechnology at the School of Engineering, where I studied polymers yielded by bacteria.

I had aspired to be a researcher since I was an undergraduate student because research was really interesting for me, but when I looked at the incredible teachers and mentors in my laboratory, I wasn't sure if it was something I could truly do myself. What I finally realized was that my experiences working in different laboratories (for my bachelor's and master's coursework) and studying two different fields gave me a unique strength. I thought that if I pursued my own uniqueness, I would be able to find my own way as a researcher.

After completing my PhD, I studied drug delivery systems (systems for delivering medicine within the body) as a postdoctoral fellow at the University of Melbourne. Although different from my previous work, I found the field of pharmacology very interesting. Furthermore, through studying abroad I learned about the differences between Japan and other countries, which really inspired me. I hope you broaden your horizons by studying abroad and interacting with international students.