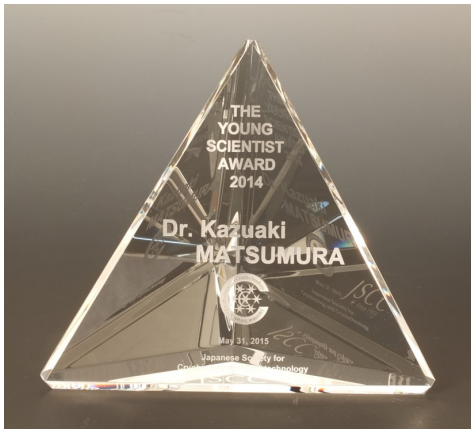
Grounds for winning the 2014 Young Scientist Award of the Japanese Society for Cryobiology and Cryotechnology

Development of novel polymeric cryoprotectants and their applications

By Dr. Kazuaki Matsumura (Associate Professor, School of Materials Science, Japan Advanced Institute of Science and Technology)



Dr. Kazuaki Matsumura is an associate professor at Japan Advanced Institute of Science and Technology (JAIST), Japan. He graduated from Kyoto University in 1998 and received his Ph.D. from Kyoto University in 2004. After that, he worked as a researcher at Japan Science and Technology Agency (JST) and his first faculty position was as an assistant professor in Kyoto University, and he then went on to become an associate professor at JAIST in 2011.

Dr. Matsumura made a great effort to develop novel polymeric cryoprotectants with his expertise in polymer chemistry. His research mainly revolved around the development of novel cryoprotectants and elucidation of their mechanisms and biomedical applications.

Cryopreservation of living cells is now indispensable in biological, medical, and agricultural research fields and in the clinical practice of reproductive medicine. It is common knowledge that cryoprotective agents such as glycerol and dimethyl sulfoxide (DMSO) solutions have been used for the cryopreservation of sperm and red blood cells because they protect them from freezing damage. However, DMSO shows high cytotoxicity and affects the differentiation of some type of cells. Thus, there is a pressing need for the development of high efficiency and low toxicity cryoprotectants.

He synthesized partially carboxylated poly-L-lysine and discovered its cryoprotective

property. This interesting phenomenon is characteristic of polymers with high electron charge, especially polyampholytes. Successful cryopreservation of many cell types, including human mesenchymal stem cells and induced pluripotent stem (iPS) cells, has been achieved. Additionally, he developed synthetic polymeric cryoprotectants using controlled polymerization technique and found that the cryoprotective property improved upon the introduction of hydrophobic residues.

He proposed that polyampholytes exert their cytoprotective action by protecting cells against stresses such as drastic changes in soluble space size and osmotic pressure during freezing by using solid-state NMR.

He developed a novel cell-sheet cryopreservation method by using polyampholyte. Cryopreservation of cell-containing constructs is in high demand in the field of tissue engineering to develop tissue-engineered products “off-the-shelf”. This facile preservation technique will open new avenues for truly industrial application of tissue-engineered constructs.

He aimed to apply these novel results to the biomedical field. For example, by hydrogelation of polyampholytes, he tried to develop the cell scaffolds with cryoprotective property for tissue engineering and he discovered novel protein delivery method by using freeze concentration mechanism.

As mentioned above, Dr. Matsumura has had numerous remarkable achievements in his research on the development of polymeric cryoprotectants and their biomedical applications. His work has significantly contributed to our society. Therefore, Dr. Matsumura deserves the 2015 Young Scientist Award of the Japanese Society for Cryobiology and Cryotechnology.