【Grant-in-Aid for Transformative Research Areas（B）】

Section II

Title of Project： Innovative nanotechnology for probing molecular landscapes in the brain

ANRAKU Yasutaka
(The University of Tokyo, Department of Engineering, Associate Professor)

Number of Research Area：21B204　Researcher Number：60581585

【Purpose of the Research Project】

Considering the brain from the viewpoint of molecular physiology, the microscopic molecular information, such as localization and dynamics of molecules, is still a black box, and there are many unanswered questions about the relationship with central nervous system (CNS) diseases. This is because there is no method to directly collect brain tissue in a non-invasive method, and also because the blood transferability of brain molecules is extremely low, making it difficult to obtain molecular information of the living brain even indirectly. For example, the microdialysis method, in which probes are inserted locally into the brain for collecting molecules, has extremely limited application in humans due to the damage to the brain. In other words, the establishment of a methodology to "collect brain molecules from the living brain non-invasively and bring this molecular information into the blood" is a core technology for understanding brain functions and diseases from the viewpoint of molecular physiology. This is a challenging research subject that has not yet been achieved. In this research, we aim to construct a Hayabusa-type nanomachine that can efficiently pass through the blood-brain barrier (BBB), sample brain molecules, and return to the blood to provide information on brain pathophysiology, which will lead to innovative diagnostics for CNS diseases, as well as bring new academic perspectives to the understanding of mass transfer in and out of the brain.

【Content of the Research Project】

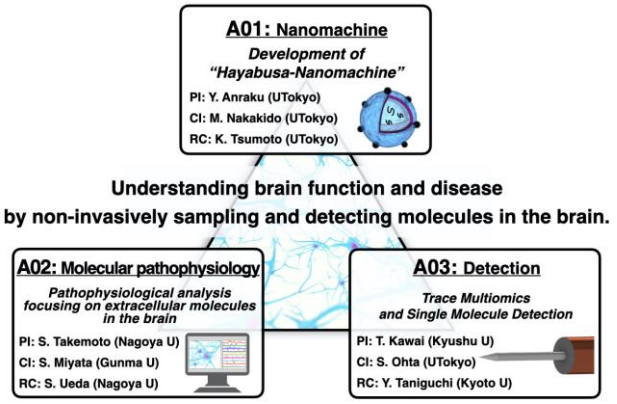

Fig. Contents and organizational chart of this research area

By gathering a team of researchers with complementary expertise in engineering, medicine and chemistry, we will elucidate the correlation between the transport of substances in and out of the brain and biological processes, and understand brain functions and diseases based on molecular information localized in the brain (Fig.). We will deepen our understanding of the relationship between the molecular environment in the brain and brain functions by comparing the molecules obtained from the brain with the molecular basis of various emotional changes and pathological conditions found in Group A02 Molecular Pathophysiology, based on the innovative technology of the "Hayabusa-type nanomachine" to be developed in Group A01 Nanomachine. In addition, by using ultra-sensitive multi-omics analysis technology to be developed in Group A03 Detection, we will analyze molecules in the brain obtained by using nanomachines to accurately understand the changes in the molecular information of the brain. In this way, we will actively share information with the management group at the core, and develop our respective researches, while continuously feeding back our progress between the team members.

【Expected Research Achievements and Scientific Significance】

The concept of a Hayabusa-type nanomachine that will be developed by this research area is an original research, that could not have been conceived without a technology that can deliver large amount of nanomachines into the brain. It is highly likely to bring about a new academic revolution and transformation in terms of understanding brain functions and diseases based on molecular brain information, and is expected to open up a new research field that will lead the way internationally.

【Key Words】

Nanomachine: A polymer assembly with a diameter of 30 to 100 nanometers (one billionth) formed by the self-assembly of highly engineered polymers that are safe for living body.

【Term of Project】

FY2021-2025

【Budget Allocation】

105,100 Thousands Yen

【Homepage Address and Other Contact Information】

HP: https://hayabusa-brain.org
Twitter: https://twitter.com/Hayabusa_brain
E-mail: anraku0915@g.ecc.u-tokyo.ac.jp