Life-signature Detection fluorescence Microscope (LDM)

*Enya Keigo[1], Yoshitaka - Yoshimura[2], Satoshi - Sasaki[3], Akihiko - Yamagishi[1,4], Atsuo - Miyakawa[4], Eiichi - Imai[5], Hajime - Mita[7], Takehiko Satoh[1], Kensei - Kobayashi[6], Yoko - Kebukawa[6], Tomoka - Okada[6], Hikaru - Yabuta[8], Takeshi - Naganuma[8], Tomoiro - Usui[1], Kazuhisa - Fujita[1]

1. Institute of Space and Astronautical Science, 2. Tamagawa University, 3. Tokyo University of Technology, 4. Tokyo University of Pharmacy and Life Science, 5. Nagaoka University of Technology, 6. Yokohama National University, 7. Fukuoka Institute of Technology, 8. Hiroshima University

Though surface of Mars is cold and dry, Mars had harboured a large amount of liquid water on the surface in early stage of the history. Several billion years ago, Mars was similar to the early Earth from which life arose, and life would have also emerged on Mars. Although the Viking mission in 1976, which explored life on Mars, did not find evidence for life [1], many findings supporting the habitability on Mars have been discovered since the Viking mission: past and present aqueous environments, organic compounds, methane and reduced compounds supporting microorganism as energy sources, and so on [2] [3]. These findings tend to suggest that microorganisms might still exist on Mars surface.

For searching extant microorganisms, a microscopic instrument is a powerful tool, which directly images life forms and identify their shapes, sizes, and other morphological and biochemical characteristics. However, it has not been used in space missions yet. For *in situ* imaging of particles and microbial cells, we have proposed the Life-signature Detection fluorescence Microscope (LDM) which visualizes organic compounds by staining the samples with fluorescent pigments [4]. The LDM scans a volume of 1 mm^3 and detects organic compounds including cells and other biological materials in high sensitivity ($<10^4$ cells per gram clay). The fluorescent pigments have been selected to identify the fundamental features of cells by differentiating organic compounds surrounded by membranes or those show enzyme activity. The LDM is also equipped with a high-resolution imaging system (1 μm/pixel) which visualizes detailed life forms as well as regolith and dust particles [5]. Our investigation goals are the followings. 1) High-resolution characterization of regolith and dust particles. 2) Search for organic compounds in Mars surface samples. The compounds include cells, other biological materials, and abiotic polycyclic aromatic hydrocarbon (PAH). 3) Identify cell-like structure in which organic compounds are enveloped by membrane, which may represent Martian life.

In this presentation we will report the current status of the development of LDM and potential application to planetary explorations.

References

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