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Structural chemistry, Molecular spectroscopy, Photo-molecular science, Biophysical chemistry

Our research interests extend over the following four major fields of physical chemistry; structural chemistry, molecular spectroscopy, photo-molecular science and biophysical chemistry (Fig. 1). Under strong interactions among researches in these fields, we are aiming at developing new methodology for studying the structure and dynamics of molecules and molecular systems, and eventually, discovering and elucidating new molecular phenomena that will innovate science and technology.

Development of new methods of Raman spectroscopy: We are developing two new Raman spectroscopic systems of our own design. They are both the "only one" apparatus unique to our group. One is multi\focus Raman micro-spectrometer that will improve the efficiency of Raman data acquisition by 100 times. The other is a deep ultraviolet hyper-Raman spectrometer with which we aim at the world first observation of electronic hyper-Raman scattering.

Biomedical applications of Raman spectroscopy: We use our laboratory constructed Raman micro-spectrometers to study living cells and tissues for fundamental biological as well as medical applications. Living cell studies include the elucidation of the "Raman spectroscopic signature of life" in yeast cells (Fig. 2), *in vivo*, non-invasive and label-free identification and diagnosis of white blood cells, and quantitative Raman-image monitoring of lipids in oil producing microalga. The medical applications include Raman big data analysis for quantifying molecular cancer markers in human oral tissues and high speed, *in situ*, and label-free human blood testing with a portable Raman spectrometer.

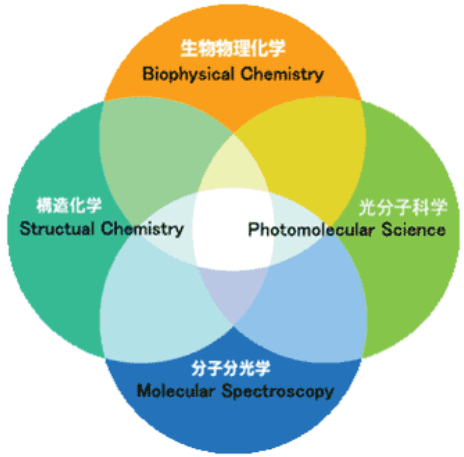

Figure 1. Four fields of physical chemistry

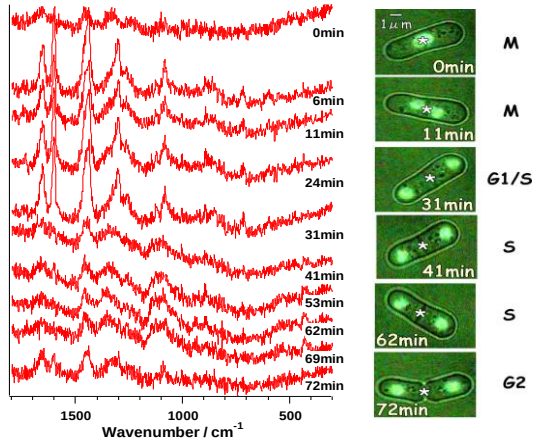

Figure 2. Time- and space-resolved Raman spectra of a dividing fission yeast cell