**Translate the following poem into Japanese**

**Never fear big words**

**Big long words name little things**

**All big things have little names**

**Such as life and death, peace and war**

**Or dawn, day, night, hope, love, home**

**Learn to use little words in big way**

**It is hard to do**

**But they say what you mean**

**When you do not know what you mean**

**Use big words**

**They often fool little people**

**by Josef Conrad (1857-1924)**

# Introduction to High Precision Analysis Using Synchrotron Radiations

In lecture 1 I will introduce specific topics and new approach to engineering imaging techniques for biomedical applications consist of:

1. Why should we use Synchrotron Radiation for high precision elemental imaging?
2. X-ray Fluorescence Spectroscopy
3. X-ray Absorption Spectroscopy
4. New approach for high precision elemental imaging technique for cellular analyses
5. Synchrotron Radiation application to differentiation of mouse ES cells
6. How can Synchrotron Radiation be used as a tool for investigation of brain function studies (Part I)?
7. How can Synchrotron Radiation be used as a tool for investigation of brain function studies (Part II)?
8. Other possible applications of elemental imaging techniques

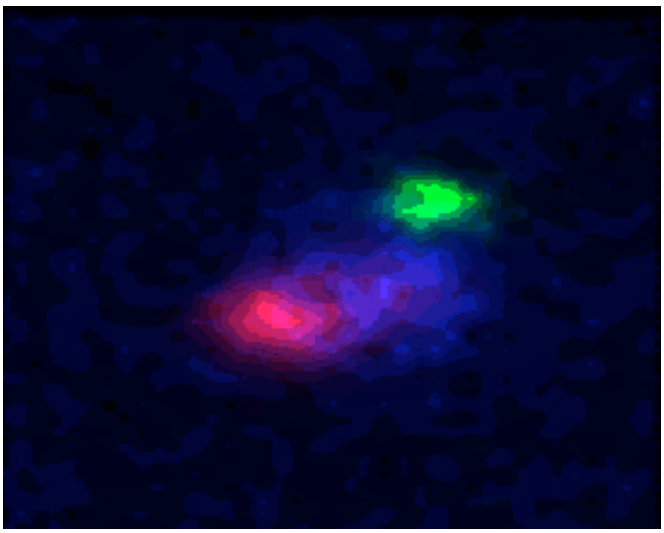
The contents of the lectures are based on the book written by Ari Ide Ektessabi "**Application of Synchrotron Radiation**" (published by Springer, 2007). The contents shown on the internet is an introduction to the topics and will neither be a replacement of the class room lectures nor a replacement to the contents of the book.

## Objective

The aim of this course is to demonstrate the applications of synchrotron radiation in certain aspects of cell microbiology, specifically non-destructive elemental analyses, chemical-state analyses and imaging (distribution) of the elements within a cell. The basics for understanding and applications of synchrotron radiation are the same as those of x-ray spectrometry, which has been well developed during the twentieth century and is widely applied to various fields of science and technology, including biology and medicine. What makes a synchrotron radiation x-ray source very useful for analytical works, especially for biological applications, are the very high brilliance and energy variability of the x-ray beam.

The two main techniques that will be discussed in lecture 1 are:

1. X-Ray Fluorescence Spectroscopy (XRF)
2. X-Ray Fine Structure Analysis (XAFS).



The multi elemental imaging shows the elemental distribution within a single cell. Red, blue and green represent the Ca, Zn, and Cr distribution and their relative concentrations in the cell. The special resolution is about 0.2 micro meters, and in the most precise case it can go below 50 nanometers. However, it is important to note that this images are usually produced by scanning the area over more than a few thousands points depending on the size and strength of the micro beam. For very small beams, below micrometers, the present available systems can not be practically useful for producing images within a reasonable experiment time. The time necessary for obtaining the above image was in the order of 1-4 hours for beams of a few micrometers.

The other topics that will be discussed are as follows:

1. A brief introduction to electron and ion accelerators in general
2. History of synchrotron radiation facilities
3. Comparison with conventional microscopy
4. Comparison with electron beam imaging and electron microscopy
5. Comparison with ion beam imaging (micro beam PIXE)
6. Comparison with electron beam imaging

## Requirements for taking the lecture

1. Read chapter 1 of the reference book.
2. Access to the homepage of one of the leading SR facilities and see what the new topics of XRF and XAFS are.

## Requirement after taking the lecture

Write a one page report on the history of synchrotron radiation and how these facilities appeared in the history of science.