

Development of diffraction microscope with low-energy coherent electron beams: - Atomic structure analysis of a single bio molecule-

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【Outline of survey】

In this project, we focus on the development of experimental apparatus and method that realize structure analysis of single bio molecules with low-energy coherent electron beams.

We investigated coherent electron beams emitted from various sources and experimental techniques for characterizing solid surfaces by using low-energy electron beams for last several years. Low-energy beams with several tens of eV to a few thousands of eV, exhibit the following advantages: (1) Low damage to the sample, (2) Large scattering cross-section for light elements such as carbon, oxygen, nitrogen and hydrogen.

In recent years, we have developed electron sources terminated with a single-atom of the tip.

Because of their extremely small emission areas, the electron beams possess the following additional characters: (1) high coherency, (2) high brightness, (3) ideal-point sources, which provide us the novel techniques to analyze the atomic structure of single molecule related to bio science.

The electron-beams just after emission, the spot size of about a few nano-meters, are highly intensive. The distance between the source and the specimen is reduced by the projection electron microscope techniques, we can expect to detect the diffraction beams from only one single-molecule. In this project, we will analyze the atomic structure of single-molecule by applying oversampling phasing method including dynamical effects to the diffraction beams.

【Expected results】

Development of this apparatus will make it possible to measure beams diffracted by one molecule of nano-meter scale. We plan to perform following experiments:

(1) We analyze the atomic structure of one carbon nanotube (CNT), and try to detect the special points of the CNT, such as pentagon, heptagon, the defects of s bond and p bond and impurities.

(2) We try to analyze atomic structures of bio-molecules, such as DNA and RNA. This is one of the most interesting applications of the low-energy electron beam emitted from single atom electron source.

【References by the principal researcher】

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【Term of project】 FY 2005 - 2007

【Budget allocation】 70,600,000 yen

【Homepage address】 <http://www.phys.waseda.ac.jp/surface/index.html>