様　式　Ｃ－１９、Ｆ－１９－１、Ｚ－１９　（共通）

科学研究費助成事業　　研究成果報告書

令和　　元 年　　５ 月 ２９ 日現在

機関番号：３２６１２
研究種目：基盤研究(A)（一般）
研究期間：2016～2018
課題番号：１６Ｈ０２２１８

研究課題名（和文）コヒーレントＸ線回折による酵母核内の核酸分布イメージング

研究課題名（英文）Visualization on the distribution of nucreic acids in yeast nucleus by using coherent X-ray diffraction

研究代表者

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研究者番号：３０２２７７６４

交付決定額（研究期間全体）：（直接経費）　　35,300,000円

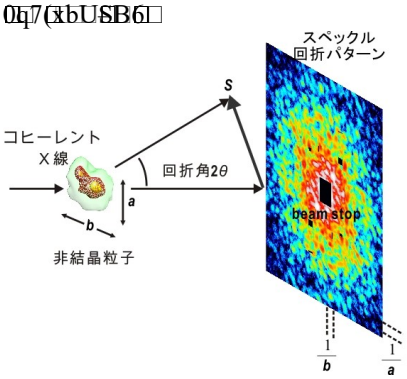
研究成果の概要（和文）：シンクロトロン放射光を用いた低温Ｘ線回折イメージング・トモグラフィーと、Ｘ線自由電子レーザーを用いた低温Ｘ線回折イメージングにおける試料作製および実験装置の高度化をおこなうとともに、新たな構造解析法を考案した。それらをもとに、バクテリア細胞や酵母細胞核の普遍的な内部構造などを可視化するとともに、バクテリア細胞や酵母細胞の三次元構造解析を行い、生体非結晶粒子の非侵襲イメージングを確立した。

研究成果の学術的意義や社会的意義
低温X線回折イメージング・トモグラフィー実験では、細胞個々の特性や細胞周期に応じた物質分布の変化を、一方、XFELを用いるX線回折イメージング実験では、大量の細胞試料の投影電子密度を得ることが可能となった。本課題の研究成果は、シンクロトロン放射光とＸ線自由電子レーザーを相補的利用によって、細胞の個性と多様性を見ることにつながり、他のイメージング手法では成しえない非侵襲的イメージングの大きな進展につながることが期待できる。今後、本手法が細胞イメージングの重要な柱の一つとなるだけでなく、非結晶金属ナノ材料試料の構造研究にも裾野を広げていくと期待できる。

研究成果の概要（英文）：In this project, we improved fundamental techniques including automatic control procedures of diffraction apparatuses, preparation of frozen-hydrated biological specimens, and measurement of spatial coherence of X-ray beam, in cryogenic X-ray diffraction imaging tomography using synchrotron X-rays and cryogenic X-ray diffraction using X-ray free electron laser pulses. In addition, we developed methods to obtain reliable electron density maps in phase retrieval calculation in structure analyses including the utilization of manifold learning. Based on these developments, we successfully established X-ray diffraction imaging technique for non-crystalline biological specimens, such as cells and organelles, through the visualization of common structures in yeast nucleus and cyanobacterium cell as well as the three-dimensional structures of yeast and bacteria cells without sectioning and chemical labeling necessary in other imaging techniques.

研究分野：生物物理学

キーワード：Ｘ線回折イメージング　放射光　Ｘ線自由電子レーザー　低温Ｘ線回折実験　位相回復　三次元再構成　細胞核　細胞非侵襲イメージング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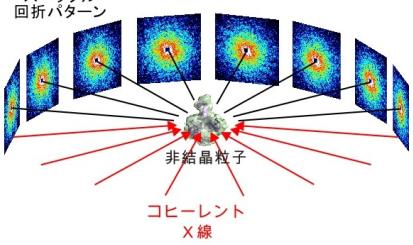
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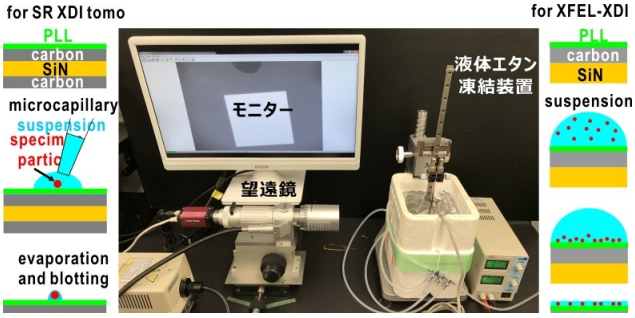
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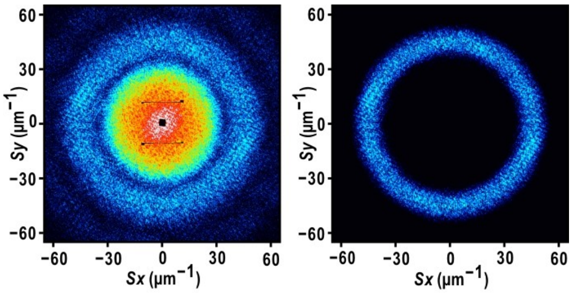

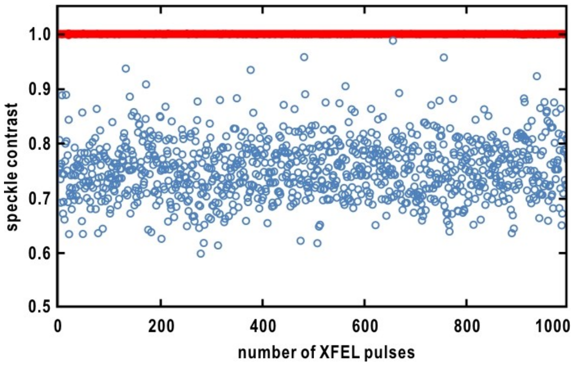

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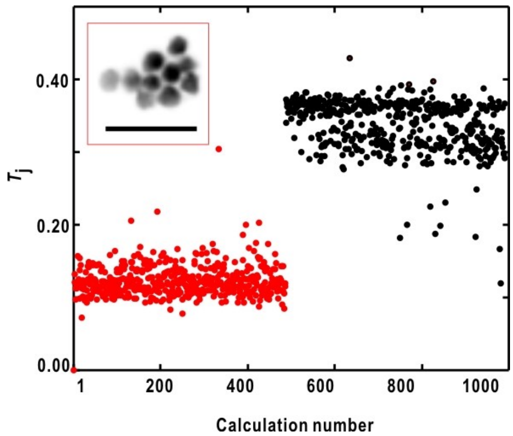

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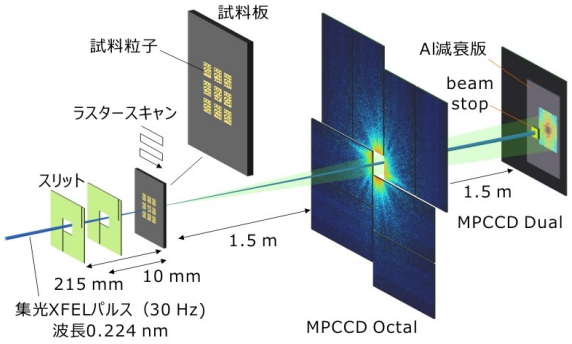

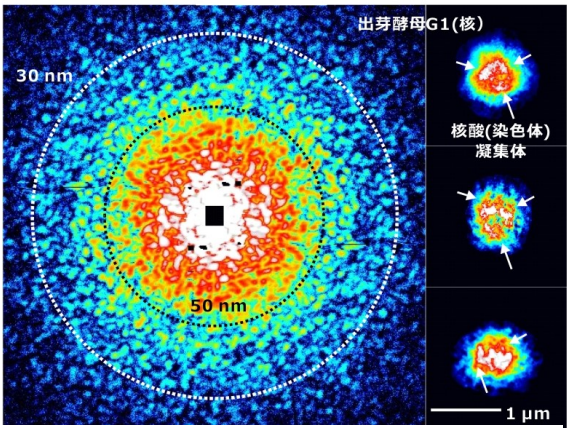

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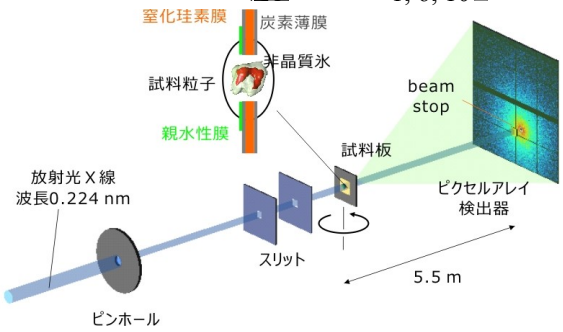

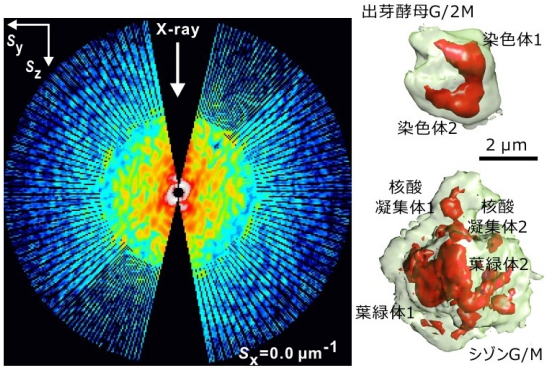

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11. [illegible] (2019) [illegible]

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19. □ □□□□ 5 □ 6 □ (2017) 7118S5b□ X)zG□b(8□ . '□ 30 G1U□
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