

3D Position Observation for Detecting 3D Motion of a Microscopic Particle

1. Technology Overview

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A three-dimensional position observation apparatus provided with a lens system having focusing and diaphram mechanisms, for forming an image on an imaging plane by light from an observation object includes a beam steering member disposed in a light path extending from the observation object to the imaging plane, for changing a traveling direction of observation light into a plurality of different directions, and an image analyzing unit for analyzing a position of the observation object based on a positional relation between a plurality of images on the imaging plane formed by light passing through the beam steering member.

2. 3D Position Observation Apparatus and Method

■ Observation System

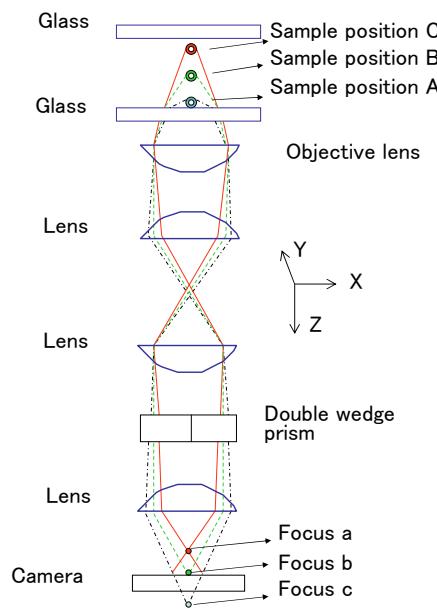


Fig.1 Essential structure

■ Sample Position and Focus

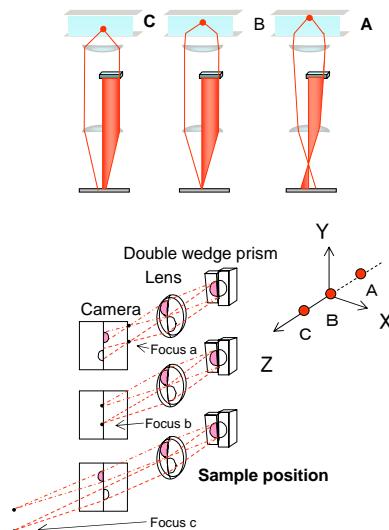


Fig.2 An image at the time of displacement of the object in a z-direction

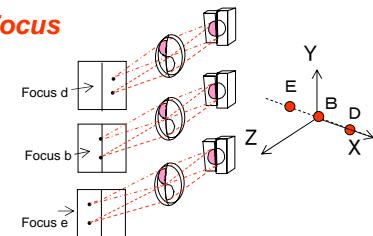


Fig.4 An image at the time of displacement of the object in a x-direction

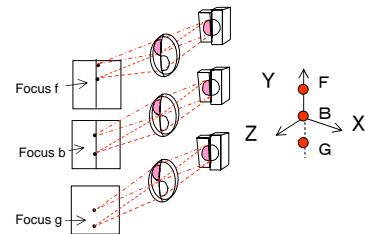


Fig.3 An image at the time of displacement of the object in a y-direction

3. Position Analysis

■ 3D Observation of Brownian Motion

(1) Observed object

• microscopic particles that are bound to fluorophore and contained in an aqueous solution.

(2) Detection of displacement in x / y direction

• Displacement in the direction parallel to the viewing plane (Fig3/4), can be determined as an absolute amount from the displacement of images on the plane.

(3) Detection of displacement in z direction (Fig.2/5)

• To determine the absolute amount of displacement in the z-direction, a relation between displacement of the objective lens and displacement in the objective lens and displacement in the x-direction was indirectly determined by moving the objective lens up and down. In this case, "relative displacement in the x-direction = 0.46 x displacement in the z-direction" was determined.

(4) Fig.6 is a graph showing this displacement in three dimensions.

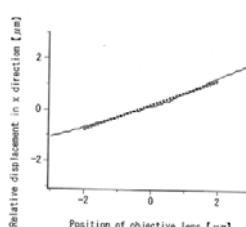


Fig.5 relative relation

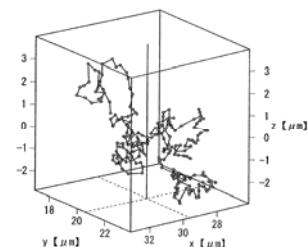


Fig.6 3D position observation

4. Observation of molecular motor

■ Observation of the corkscrew motion of a sliding microtubule driven by Eg5 under a 3D tracking microscope.

(Yajima, J., Mizutani K. & Nishizaka T. , Nat. Struct. Mol. Biol. 15, (2008).

Mitotic kinesin Eg5 is a homotetrameric molecular motor that cross-links and slides microtubules. The extent to which Eg5 moves processively is not clear. Three-dimensional tracking of a quantum dot (QD) attached to the microtubule in a motility assay is used to directly visualize the corkscrew motion of a sliding microtubule. It is shown that the rotational pitch of the driving motors, confirming that two-headed Eg5 is much less processive than two-headed kinesin-1.

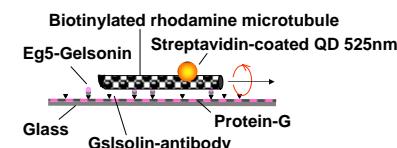


Fig.7 DiaGram of the in vitro microtubule sliding assay

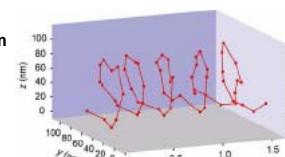


Fig.8 3D plot of QD bound to a sliding microtubule

5. Patent status & Patent owner contact

■ Patent license is available.

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Apply country : JP,US,CA,CN,EP

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