

Jun 05, 2025

Version 2

🌐 LRRK2^{RCKW} single molecule kinesin motility assays_2024 V.2

🔗 Version 1 is forked from [LRRK2RCKW single molecule kinesin motility assays](#)

📖 [Science Advances](#)

DOI

<https://dx.doi.org/10.17504/protocols.io.5qpvok4dzl4o/v2>

John Salogiannis¹, Katherine Surridge²

¹Department of Cellular and Molecular Medicine, University of California, San Diego, La Jolla, CA 92093; ²UCSD



Katherine Surridge

UCSD

LRRK2^{RCKW} single molecule kinesin motility assays

Create & collaborate more with a free account

Edit and publish protocols, collaborate in communities, share insights through comments, and track progress with run records.

Create free account

OPEN  ACCESS



DOI: <https://dx.doi.org/10.17504/protocols.io.5qpvok4dzl4o/v2>

External link: <https://doi.org/10.1126/sciadv.adt2050>

Protocol Citation: John Salogiannis, Katherine Surridge 2025. LRRK2RCKW single molecule kinesin motility assays_2024. protocols.io <https://dx.doi.org/10.17504/protocols.io.5qpvok4dzl4o/v2> Version created by [Katherine Surridge](#)

Manuscript citation:

Raig ND, Surridge KJ, Sanz-Murillo M, Dederer V, Krämer A, Schwalm MP, Lattal NM, Elson L, Chatterjee D, Mathea S, Hanke T, Leschziner AE, Reck-Peterson SL, Knapp S Type II kinase inhibitors that target Parkinson's disease-associated LRRK2. Science Advances 11(23). doi: [10.1126/sciadv.adt2050](https://doi.org/10.1126/sciadv.adt2050)

License: This is an open access protocol distributed under the terms of the [Creative Commons Attribution License](#), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited

Protocol status: Working

We use this protocol and it's working

Created: December 09, 2024

Last Modified: June 05, 2025

Protocol Integer ID: 114635

Keywords: LRRK2, motility assay, kinesin, imaging, single-molecule, ASAPCRN, Irrk2rckw single molecule kinesin motility assay, single molecule kinesin motility assays-2024 this protocol, single molecule kinesin motility assays-2024, single molecule kinesin motility assay, Irrk2rckw, assay

Funders Acknowledgements:

ASAP

Grant ID: ASAP-000519

Abstract

This protocol is about LRRK2^{RCKW} single molecule kinesin motility assays. Forked from dx.doi.org/10.17504/protocols.io.ewov14qykvr2/v1

Attachments



[LRRK2RCKW](#)

[singlemole...](#)

82KB



Guidelines

Image Recommendation:

Settings will vary per microscope. We imaged K560-GFP every 500 msec for 2 mins with 20% laser (488) power at 150 ms exposure time.

Image using the 405 nm laser to determine the locations of the microtubules. Preferably at the start and end of the experiment.

Single-molecule motility assay analysis recommendation:

Kymographs were generated from motility movies and quantified for percent motility, using ImageJ (NIH). Specifically, maximum-intensity projections were generated from time-lapse sequences to define the trajectory of particles on a single microtubule. The segmented line tool was used to trace the trajectories and map them onto the original video sequence, which was subsequently re-sliced to generate a kymograph. Motile and immotile events were manually traced. For percent motility per microtubule measurements, motile events (> 1 sec and $> 1\mu\text{m}$) were divided by total events per kymograph. Statistical analyses were performed in Prism8 (Graphpad).

Materials

Recommended Equipment and Setup:

This single-molecule imaging experiment was originally performed using total internal reflection fluorescence (TIRF) microscopy with an inverted microscope (Nikon, Ti-E Eclipse) equipped with a 100× 1.49 N.A. oil immersion objective (Nikon, Plano Apo), and a MLC400B laser launch (Agilent), with 405 nm, 488 nm, 561 nm and 640 nm laser lines (561 and 640 nm laser lines are not needed for this version of the experiment). Excitation and emission paths were filtered using single bandpass filter cubes (Chroma), and emitted signals were detected with an electron multiplying CCD camera (Andor Technology, iXon Ultra 888). Illumination and image acquisition were controlled with NIS Elements Advanced Research software (Nikon), and the xy position of the stage was controlled with a ProScan linear motor stage controller (Prior).

Required Buffers:

Streptavidin/Biotin Buffer:

- [M] 1 mg/mL Streptavidin
- [M] 30 millimolar (mM) HEPES pH 7.4
- [M] 2 millimolar (mM) MgOAc
- [M] 1 millimolar (mM) EGTA
- [M] 10 % Glycerol

Motility Assay Buffer:

- [M] 30 millimolar (mM) HEPES pH 7.4
- [M] 50 millimolar (mM) KOAc
- [M] 2 millimolar (mM) MgOAc
- [M] 1 millimolar (mM) EGTA
- [M] 10 % Glycerol
- [M] 1 millimolar (mM) DTT
- [M] 20 micromolar (μM) Taxol

Motility Assay Buffer with casein:

- [M] 30 millimolar (mM) HEPES pH 7.4
- [M] 50 millimolar (mM) KOAc



- [M] 2 millimolar (mM) MgOAc
- [M] 1 millimolar (mM) EGTA
- [M] 10 % Glycerol
- [M] 1 millimolar (mM) DTT
- [M] 20 micromolar (μ M) Taxol
- [M] 1 mg/mL casein

LRRK2 Buffer:

- [M] 20 millimolar (mM) HEPES pH 7.4
- [M] 80 millimolar (mM) NaCl
- [M] 0.5 millimolar (mM) TCEP
- [M] 5 % Glycerol
- [M] 2.5 millimolar (mM) MgCl₂
- [M] 20 micromolar (μ M) GDP

Safety warnings

! For hazard information and safety warnings, please refer to the SDS (Safety Data Sheet).

Before start

Please take notice of the buffer preparation in section 'Materials'.

Make sure that you have labeled taxol-stabilized microtubules available. See the [protocol](#) here.



Create microscope slides:

1h 11m

- 1 Adhere coverslips (Corning) to a microscope slide using double-sided scotch tape, creating 4 channels per slide.
- 2 Add 1 mg/mL biotin-BSA (Sigma) to each channel and incubate for 00:03:00 3m
- 3 Wash twice with Motility Assay buffer.
- 4 Add 0.5 mg/mL Streptavidin to each channel and incubate for 00:03:00 3m
- 5 Wash twice with Motility Assay buffer.
- 6 Add a 1:100 dilution of taxol-stabilized microtubules (18 μ L per channel) and incubate for 00:03:00 3m

See <https://dx.doi.org/10.17504/protocols.io.bp2l6bdedgqe/v1> for making taxol-stabilized microtubules.
- 7 Wash twice with 18 μ L LRRK2 buffer. Add more buffer if necessary to prevent drying out throughout experiment.

Prepare LRRK2:

1h 11m

- 8 Prepare a 1 micromolar (μ M) solution of LRRK2^{RCKW} in a cold LRRK2 buffer. Centrifuge through a 0.1 μ m PVDF filter to remove aggregates. Calculate the new effective concentration. Usually around 500 nanomolar (nM) - 700 nanomolar (nM) after centrifugation.
- 9 Create a working aliquot of LRRK2 in the desired concentration (ex. 25 nanomolar (nM) - 100 nanomolar (nM)) in the LRRK2 buffer at Room temperature (recommended volume of 25 μ L). If adding inhibitors, add them now with DMSO. Incubate for 00:10:00 at Room temperature 10m



Next steps:

5m

10 Add LRRK2^{RCKW} sample to the channel ( 25 μ L). Incubate for  00:05:00 .
Prepare next step while waiting.

5m



11 Wash twice with the motility assay buffer supplemented with [M] 1 mg/mL casein .



Prepare kinesin:

12 Make a [M] 1.9 nanomolar (nM) solution of K560-GFP in the Motility Assay buffer with casein supplemented with an oxygen scavenger system ([M] 0.4 % glucose , [M] 45 Mass Percent glucose catalase (Sigma-Aldrich), and [M] 1.15 mg/mL glucose oxidase (Sigma-Aldrich)), [M] 71.5 millimolar (mM) beta-mercaptoethanol and [M] 1 millimolar (mM) ATP .



Next steps:

13 Add  18 μ L kinesin mixture to each chamber.

14 Image slide.