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Single-molecule pulldown for immunodetection of protein aggregates

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We use this protocol and it's working

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Abstract

This protocol describe the procedures used to clean and passivate a coverglass surface, functionalise it with biotin and specifically immobilise proteins of interest for detection with single channel imaging (SiMPull), two-colour coincidence aggregate detection (STAPull) or ThT detection (SAVE imaging) on a TIRF microscope. This protocol supports published work (Saleeb et al., 2023).

Materials

Equipment:

- Diener Electronic ZeptoOne Plasma Cleaner
- Oxford Nanoimager

Consumables:

- Coverslips (Merck, C9056-1CS)
- Ibidi 18-well gasket (Ibidi, 81818)
- 0.02-micron syringe filters (Merck, WHA68092002)

Reagents:

- Potassium hydroxide (Merck, 221473-500G)
- Acetic acid (Merck, 33209-2.5L-M)
- APTMS (Merck, 281778-5ML)
- Methanol (Merck, 32213-2.5l-M)
- mPEG-SVA (5000 Da, Laysan Bio)
- Biotinylated mPEG-SVA (5000 Da, Laysan Bio)
- Sodium hydrogen carbonate (Fisher Scientific, 10020510)
- Streptavidin (ThermoFisher Scientific, 21122)
- Capture antibody, PS129 anti-aSynuclein (Abcam, ab209422) biotinylated by kit (Pierce, 90407)
- Detection antibody, 1:1 mix of PS129 anti-aSynuclein labelled with AF488 or labelled with AF647 by kit (ThermoFisher, A20181/6)
- Thioflavin T (Merck, 596200-500MG)

Troubleshooting

Coverslip passivation and functionalisation

- 1 Treat coverslips with argon plasma for 45 mins
- 2 Immerse coverslips in 0.22 micron-filtered 1M potassium hydroxide for 20mins
- 3 Rinse coverslips in ultrapure deionised water and immerse in APTMS solution (prepared as 3.75 mL glacial acetic acid, 1 mL APTMS, 75 mL methanol) and incubate covered for 20 mins at RT.
- 4 Rinse coverslips sequentially in methanol and ultrapure deionised water and use fast flowing argon to dry slides rapidly. Inspect slide to ensure visually clean.
- 5 Attach 18-well Ibidi sticky-slide chamber to coverslip, apply pressure to ensure fully adhered.
- 6 Dispense 50 uL mPEG solution per well (95mg/mL mPEG-SVA, 5 mg/mL biotin-PEG, 0.1M sodium hydrogen carbonate), parafilm seal chamber and incubate covered overnight at RT.

Sample pull-down and labelling

- 7 Empty PEG solution by inversion and wash wells with ultrapure deionised water x3
- 8 Dry wells thoroughly using fast-flowing argon gas
- 9 Apply 50 uL 0.2 mg/mL streptavidin prepared in 0.02-micron filtered T50 buffer (10 mM Tris pH 8.0 supplemented with 50 mM sodium chloride) per well and incubate covered for 10mins at RT
- 10 Wash wells with 0.02-micron filtered T50 buffer x3
- 11 Apply 50 uL of 100 nM biotinylated capture antibody and incubate covered for 20 mins at RT
- 12 Wash wells with 0.02-micron filtered PBS x3



- 13 Apply 50 uL neat CSF per well and incubate covered for 24 hours at RT
- 14 Wash wells with 0.02-micron filtered PBS x3

NB. CSF is biohazardous, aspirate to remove liquid waste instead of slide inversion
- 15 Apply 50 uL 2nM fluorophore-labelled detection antibody and incubate covered for 3 hours at RT
- 16 Wash wells with 0.02-micron filtered PBS x3
- 17 Apply 50 uL PBS per well and image immediately

Thioflavin T preparation

- 18 Prepare approx. 4 mM stock of ThT in 100% ethanol and vortex extensively (approx. 1 hour)
- 19 Prepare approx. 200 uM ThT dilution in PBS, vortex thoroughly (approx. 20 mins) and filter through 0.02-micron filter.
- 20 Measure concentration of ThT preparation using a DeNovix spectrophotometer (extinction coefficient $36,000 \text{ M}^{-1} \text{ cm}^{-1}$ at 412 nm)
- 21 Prepare a 10 uM working stock in 0.02-micron filtered PBS

Imaging

- 22 Acquire an 8×8 grid of 200-micron spaced fields of view per well by total internal reflection fluorescence microscopy using the ONI Nanoimager with 100x/1.4 oil immersion objective lens. Samples are sequentially excited at 638nm and 488 nm, 20 frames captured per field in each channel at 20 frames s^{-1} .
- 23 On completion of imaging one well, return to position 0 (based on metadata values), cautiously apply 50 uL 10 uM ThT and re-image all fields with 405nm excitation.

