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Illuminating brain neurochemistry with nanosc probes

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Until recently, imaging the spatial and temporal propagation of neurochemical signals was not possible despite the importance of neurochemistry in supporting neurotypical development, with aberrations thereof driving numerous psychiatric and developmental disorders. We present a library of nanoscale near-infrared fluorescent nanosensors to image synaptic-scale neurochemical propagation of dopamine (Beyene et al. Science Advances 2019; Yang et al. Nature Protocols 2021), serotonin (Jeong et al. Science Advances 2019), and oxytocin (Mun et al. PNAS 2024), and describe how to implement our nanosensors to image neurochemical signaling in living brain tissue. We show that our dopamine probes can uncover synaptic-scale mechanisms of neurochemical signaling aberrations in Huntington's Disease model mice, in which neurons lose their ability to effectively release dopamine. We also show that our oxytocin nanosensors can be used to study non-reproductive peer relationships in voles and find that oxytocin signaling is impaired in voles that show decreased peer relationship preferences. We finally discuss the relevance of our findings for supporting advances in understanding and treating neuro-degenerative disease, psychiatric conditions, and autism spectrum disorders.

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Schlagwörter

Physics

Biophysics

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