

**Structural insight into synaptic function**

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Synaptic transmission depends on the coordinated action of organelles such as synaptic vesicles and protein complexes including neurotransmitter receptors and scaffolding molecules. Yet exactly how these components are organized in situ and how their configurations change during synaptic development, transmission remains unclear. Using super-resolution optical imaging, we identify morphological features of silent and active synapses during development. To interrogate the structural correlates of synaptic function, we use cryo-electron tomography (cryoET) and correlated light-electron microscopy to reveal a “mesophasic” organization of neurotransmitter receptors and scaffolding molecules in intact synapses and uncover a “kiss–shrink–run” mechanism of vesicle exocytosis and recycling during synaptic transmission. We further demonstrate existence of different structural states of ribosomes in the synapse and their changes accompanying the induction of synaptic plasticity.