HEKA

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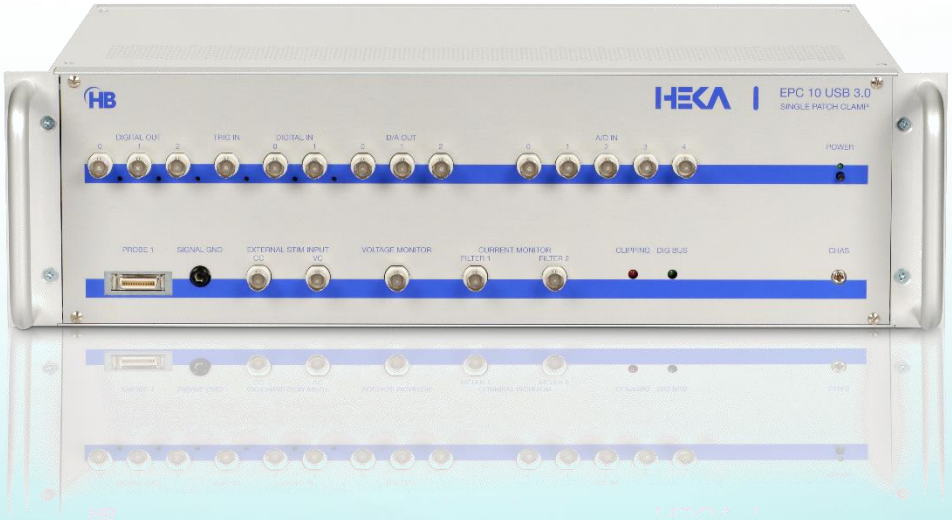
应用及精选论文
（神经元记录）



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HEKA膜片钳解决方案在科学研究中的应用

- HEKA于1982年推出首款膜片钳放大器。此后，HEKA放大器已被引用近12,000次，其中，单EPC 10型号就被引用了近8,000次。
- Warner的活细胞成像、电生理和膜片钳研究配件已被引用大约50,000次。
- 本文件仅提供近期发表的少量论文示例，论证HEKA膜片钳解决方案的应用场景。

神经元记录

膜片钳记录可通过两种方式进行：电流钳或电压钳模式。前者用于观察膜电位(Vm)，后者用于研究跨细胞膜的离子电流。

使用膜片钳技术可研究任何可兴奋细胞（尤其是神经元等小型细胞），且该技术可与外细胞记录成像（荧光、双光子等）、光遗传学或RNA测序等技术联用。

目前，膜片钳记录已广泛应用于从细胞培养到脑片和活体动物在体准备的各种实验场景。

HEKA硬件及软件(EPC 10 USB 3.0 & PATCHMASTER NEXT) 支持所有可能的应用，并以高质量结果著称。其3合1功能（控制放大器、数据采集与数据分析）使用户能够创建复杂实验协议并实现高度实验自由度。

神经元兴奋性、可塑性与突触传递:

- Yang, D. et al. Modulation of large rhythmic depolarizations in human large basket cells by norepinephrine and acetylcholine. Commun Biol;7(1):885 (2024). https://doi.org/10.1038/s42003-024-06546-2
- Hu, R. et al. α2-Adrenergic modulation of Ih in adult-born granule cells in the olfactory bulb. Front. Cell. Neurosci., Sec. Cellular Neurophysiology. Volume 16 (2022). https://doi.org/10.3389/fncel.2022.1055569
- Sakamoto M. et al. A Flp-dependent G-CaMP9a transgenic mouse for neuronal imaging in vivo. Cell Rep Methods;2(2):100168 (2022). https://doi.org/10.1016/j.crmeth.2022.100168
- Imbrosci, B. et al. Subiculum as a generator of sharp wave-ripples in the rodent hippocampus. Cell Rep; 35(3):109021 (2021). https://doi.org/10.1016/j.celrep.2021.109021

- Koos, K. et al. Automatic deep learning-driven label-free image-guided patch clamp system. Nat Commun 12, 936 (2021). https://doi.org/10.1038/s41467-021-21291-4
- Cong, Q. et al. The endogenous neuronal complement inhibitor SRPX2 protects against complement-mediated synapse elimination during development. Nat Neurosci 23, 1067–1078 (2020). https://doi.org/10.1038/s41593-020-0672-0
- Wang, JJ. et al. Disruption of auto-inhibition underlies conformational signaling of ASIC1a to induce neuronal necroptosis. Nat Commun 11, 475 (2020). https://doi.org/10.1038/s41467-019-13873-0
- Kuijpers, M. et al. Neuronal Autophagy Regulates Presynaptic Neurotransmission by Controlling the Axonal Endoplasmic Reticulum. Neuron 109 (2), (2020). https://doi.org/10.1016/j.neuron.2020.10.005

突触胞吐作用与胞吞作用:

- Hartveit, E. et al. Capacitance Measurements of Exocytosis From AII Amacrine Cells in Retinal Slices. Bio Protoc; 15(1):e5147 (2025). https://doi.org/10.21769/BioProtoc.5147
- Laporte, M.H. et al. Alix is required for activity-dependent bulk endocytosis at brain synapses. PLoS Biol; 20(6):e3001659 (2022). https://doi.org/10.1371/journal.pbio.3001659
- Vandael, D. et al. Short-Term Plasticity at Hippocampal Mossy Fiber Synapses Is Induced by Natural Activity Patterns and Associated with Vesicle Pool Engram Formation. Neuron 107 (3), (2020). https://doi.org/10.1016/j.neuron.2020.05.013

癫痫、致痫性与神经毒性:

- Henning, L. et al. Reactive microglia are the major source of tumor necrosis factor alpha and contribute to astrocyte dysfunction and acute seizures in experimental temporal lobe epilepsy. Glia; 71(2):168-186 (2023). https://doi.org/10.1002/glia.24265

神经系统疾病:

- Libé-Philippot, B. et al. Synaptic neoteny of human cortical neurons requires species-specific balancing of SRGAP2-SYNGAP1 cross-inhibition. Neuron; 112(21):3602-3617.e9 (2024). https://doi.org/10.1016/j.neuron.2024.08.021
- Calafate, S. et al. Early alterations in the MCH system link aberrant neuronal activity and sleep disturbances in a mouse model of Alzheimer's disease. Nature Neuroscience; 26,1021–1031 (2023). https://doi.org/10.1038/s41593-023-01325-4
- Götz, S. et al. Heterogeneity of astrocytes: Electrophysiological properties of juxtavascular astrocytes before and after brain injury. Glia 69 (2), (2021). https://doi.org/10.1002/glia.23900

痛觉:

- Daniluk, J. et al. pH-dependent modulation of TRPV1 by modality-selective antagonists. Br J Pharmacol; 180(21):2750-2761 (2023). https://doi.org/10.1111/bph.16173
- Aloi, D.V. et al. TRPM3 as a novel target to alleviate acute oxaliplatin-induced peripheral neuropathic pain. Pain; 164(9):2060-2069 (2023). https://doi.org/10.1097/j.pain.0000000000002906

在体膜片钳：

- Otomo, K. et al. In vivo patch-clamp recordings reveal distinct subthreshold signatures and threshold dynamics of midbrain dopamine neurons. Nat Comm 11, 6286 (2020). https://doi.org/10.1038/s41467-020-20041-2
- Lee, D. & Lee, A.K. In Vivo Patch-Clamp Recording in Awake Head-Fixed Rodents. Cold Spring Harb Protoc 4, (2017). https://doi.org/10.1101/pdb.prot095802
- Neugebauer, U. et al. Combination of Patch Clamp and Raman Spectroscopy for Single-Cell Analysis. Anal. Chem. 83, (2011). https://doi.org/10.1021/ac1024667

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