KCL Bridge Electrode Holder™

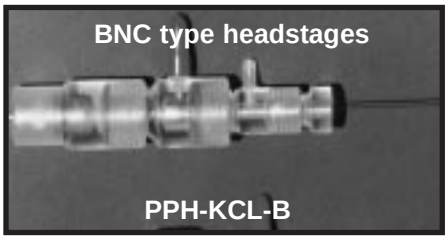
Easy-to-use electrode holder for microelectrodes to stabilize electrode potentials and eliminate Cl- from recording solution.....

Electrophysiological techniques require stable electrode potentials for accurate readings. For stability, electrodes must be reversible and mechanically isolated from stress, strain, and non-equilibrium chemical exposure. Ag/AgCl electrodes are the most common reversible electrodes used for patch clamp & intracellular recording pipettes. These are readily prepared from silver wire or sintered Ag/AgCl pellets. In pipettes the wire is easiest to use since it can be simply inserted into the back of a saline filled pipette. Because of their larger surface area, the sintered pellets are more stable, but may accumulate bubbles at the fluid pellet interface.

For AgCl electrodes to be reversible, the filling solution must have mobile Cl- ions. This is not always possible, particularly in biophysical experiments where pipettes may contain a wide range of anions other than Cl- such as F-, gluconate, etc. Under these conditions, the AgCl pellet forms a non-reversible electrode interface whose potential drifts with time and usually requires large offset potentials from the amplifier to back standing currents. Similar problems may occur from simply scratching the Cl- coating on a silver wire by inserting it into the unpolished pipette. This leaves a metallic Ag and an AgCl interface in contact with the filling solution creating an unstable battery. We have designed a simple electrode holder that minimizes these problems.[1]

KCL Bridge:

- Eliminates need for Cl containing solutions in recording pipettes
- Provides stable offset potential
- Improves noise performance
- Easy set-up and disassembly
- Available for all glass sizes
- Connections for all amplifiers
- Completes circuit from AgCl pellet to recording electrode via quartz capillary



The basic idea is to replace the AgCl wire with a fluid filled quartz capillary tube. The tube is connected to a KCl filled reservoir containing a Ag/AgCl pellet. Polyamide coated quartz tubes developed for HPLC are extremely sturdy, flexible, inert, and often used as filling needles for pipettes. They can be repeatedly inserted into pipettes without damage. The KCl fluid path through the capillary provides a liquid junction interface with minimal offset potentials, particularly when the KCl concentration is much higher than the pipette solution. This is because the K+ and Cl- mobilities are similar and dominate the diffusion potential when the concentration is much higher than the pipette solution.[2] Typical liquid junction potentials would be below 15 mV, even for uncommon ionic compositions.

One can insert the tip of the capillary into a pipette filled with, for instance, KF solution, and expect stable offset potentials. The capillary has the additional advantage of low capacitance that reduces the noise produced by the voltage noise of the patch input stage. The capillary tubing is available in 200µm and 100µm interior diameter, a much smaller diameter than the 0.25mm typical diameter of most silver wires. Since the capacitance of a wire is proportional to the logarithm of the diameter, small wires have lower capacitance than large wires. Smaller wires produce lower amplifier noise in the high frequency range.[3] However, it should be noted that this advantage is only attained when the pipettes themselves are minimally filled.

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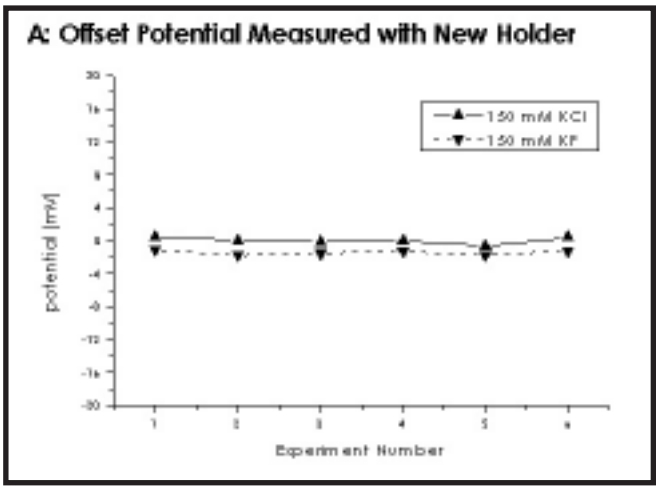
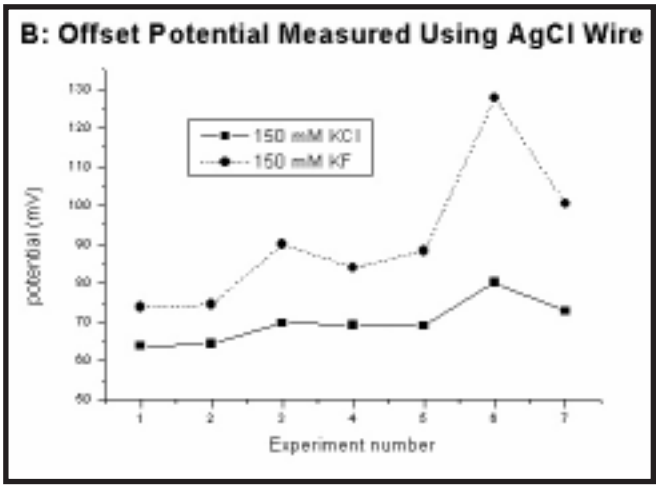


Offset potentials measured using the KCL Bridge holders (A) and conventional holder (B) w/AgCl wire.
Note the different "Y" axis values.



Ordering Details and Accessories

PPH-KCL-AXC	KCL bridge pipette holder for Axon Axoclamp 2A Type Headstage
PPH-KCL-AXP	KCL bridge pipette holder for Axon 1D/200A Type Headstage
PPH-KCL-AU	KCL bridge pipette holder for Axon Universal Type Headstages
PPH-KCL-BNC	KCL bridge pipette holder for BNC Type Headstages

References

1) Snyder, Kriegstein, & Sachs, A convenient electrode holder for glass pipettes to stabilize electrode potentials, Pflugers Arch. 438: 405-411 (1999).

2) Benndorf 1995 Low-noise recording. In Single Ch. Recording pp. 129-146.

3) Bockris & Reddy 1970, Modern Electrochemistry, Plenum Press, NY.