Microelectrodes

HEKA offers metal microelectrodes and carbon fiber microelectrodes. All our microelectrodes have a gold connector pin and can easily be connected to a HEKA Preamplifier by use of the HEKA Microelectrode Holder. The metal microelectrodes used for electrochemistry have flat tips (so called microdisc electrodes) in order to obtain faradaic currents. For electrophysiological applications sharp tips are often used.

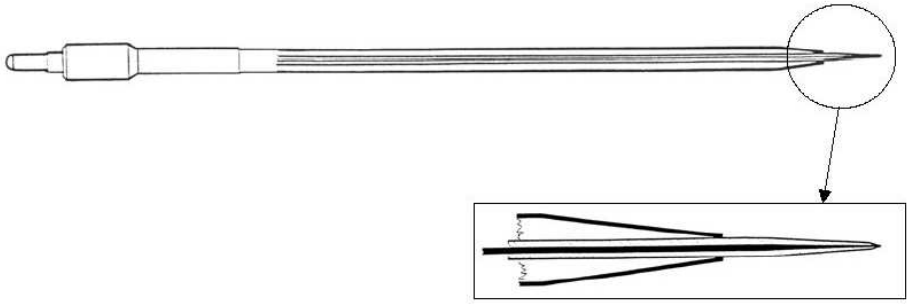

Figure 1: Scheme of a metal microelectrode for electrophysiology

Single Core Quartz-Platinum Microdisc Electrodes

The Pt-microdisc electrodes which are offered by HEKA have electroactive tip diameters of 1 μm, 5 μm and 10 μm. The disc core is surrounded by quartz glass and the thickness of the isolation at the tip is specified by the RG value. Other RG values, other tip diameters and alloys of Platinum with Tungsten, Rhodium or Iridium are available on request. Gold or Silver can not be covered by quartz glass because of the strongly different melting points.

RG	Electroactive Core Metal, quartz glass isolation	
15	Platinum	
10	Platinum	
8	Platinum	
4	Platinum/Tungsten	(90/10)% or (95/5)%
3	Platinum/Rhodium	(90/10)% or (95/5)%
3	Platinum/Iridium	(90/10)% or (95/5)%

Table 1: Electroactive core materials

RG Value and Electroactive Diameter

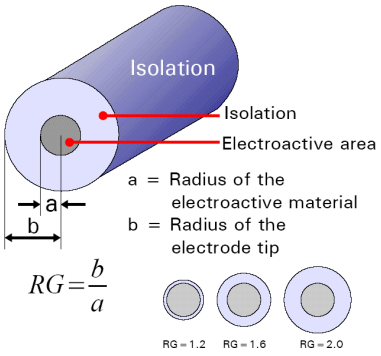

Figure 2: RG at microdisc electrodes

A microdisc electrode consists of an electroactive material surrounded by an isolation. The arrangement is coaxial and cylindrical (Figure 2). The electroactive area A is defined as:
$A = \pi a^2$.

The impedance depends on the electroactive area, which is well defined. The surface is polished and smooth.

Metal Microelectrodes for Electrophysiology

The difference between a microelectrode for electrochemistry and electrophysiological applications is the tip shape. The electroactive core materials are the same as given in Table 1, the isolation exists of quartz glass. The sharp tip can be grinded or pulled and grinded like shown in Figure 3.

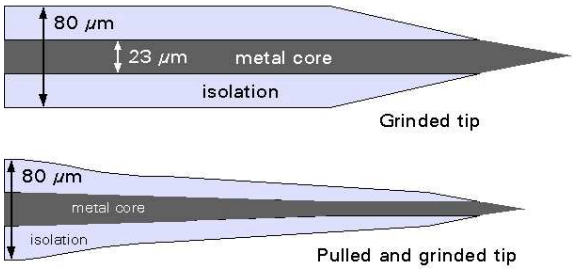

Figure 3: Tips used for Electrophysiology: Grinded (top) and Pulled & Grinded (bottom) electrode tip

Grinded Tips: Impedance value: 300 – 500 kOhms at 1 kHz. Example applications: recordings of Local-Field-Potentials, microstimulation of brain tissue.

Pulled & Grinded Tip: The double conical tip shape is achieved by pulling and grinding of the Quartz-Pt/T-fiber. Impedance value 1-10 MOhms at 1 kHz. Example application: exocytosis, local release of neurotransmitters.

The impedance depends on the electroactive surface which can be varied by a certain grinding angle for the sharp tip. Different impedance values, therefore, can be achieved. A photograph of a pulled and grinded tip is shown in Figure 4.

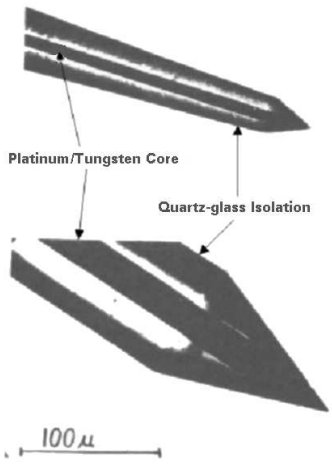

Figure 4: Photograph of tip profiles

Carbon Fiber Microdisc Electrodes

The carbon fiber microelectrodes have an electroactive diameter of 5 μm. It is a glassy carbon fiber. The glassy carbon is a special kind of electroactive carbon which has in aqueous solution a wider potential range than platinum. The isolation of the carbon fiber is achieved by electrochemical deposition of a polymer which covers the fiber. Before the first use of the carbon fiber electrode the user has to cut the tip of the fiber in order to obtain the electroactive center. The tip can be cut off more times when the electroactive area is covered by adsorption. The RG value is normally smaller than the RGs of the Pt-microdisc electrodes which are covered by glass, because the thickness of the polymer coating can be controlled electrochemically.

Mounting to the HEKA Microelectrode Holder

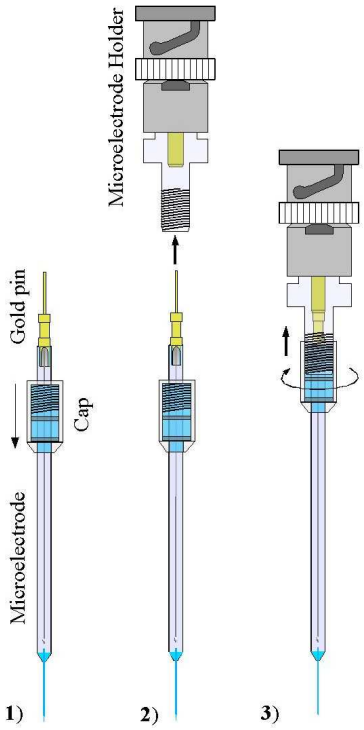

Figure 5: Mounting a microelectrode to the HEKA Microelectrode Holder.

Overview Microelectrodes

	Carbon Fiber Microdisc Electrode	Pt-Microdisc Electrode
Electroact. diameters	5 μm	1 μm, 5 μm, 10 μm others on request
RG value	< 2	At 1 μm ≥ 2 , see Table 1
Quality control	N/A	Certificate with cyclic voltammogram
Electroact. material	Glassy carbon	Pure Pt or alloys of Pt.
Isolating material	Polymer, deposited by EDP-method, = Anodic Electrophoretic Deposition of Paint	Quartz glass
Before using it	Cut off the tip of the fiber !	N/A
Connection to the amplifier	Gold pin at the rear edge, ready to use with HEKA microelectrode Holder	Gold pin at the rear edge, ready to use with HEKA microelectrode Holder
User specific parameters	N/A	RG value, tip diameter, tip material
Using in different solvents / media	Polymer coating can be destroyed in organic solvents, strong acids and bases	Can be used in various media except of HF, strong oxidizing or complex forming reactives
Potential range in aqueous solution at pH 7 (Na_2HPO_4 / KH_2PO_4 buffer) vs. 0.1 M Calomel Electrode	≈ - 1V ... +1V, depending on supporting electrolyte. At high anodic potentials the glassy carbon can be oxidized in presence of dissolved oxygen forming CO_2.	≈ - 0.3V ... +0.7V, depending on supporting electrolyte. Anodic formation of Pt-oxides, cathodic formation of hydrogen.

Order Information

When ordering please specify:

Electrophysiology
- Metal core material (Table 1)
- Tip shape: Grinded or Pulled & Grinded
- Impedance value: between 1 and 10 MOhm at 1 kHz

Electrochemistry
- Metal core material (Table 1)
- Electroactive diameter of the flat tip
- RG value
- Different RGs or electroactive diameters are available on request

Multi-core and custom-made electrodes are available on request.