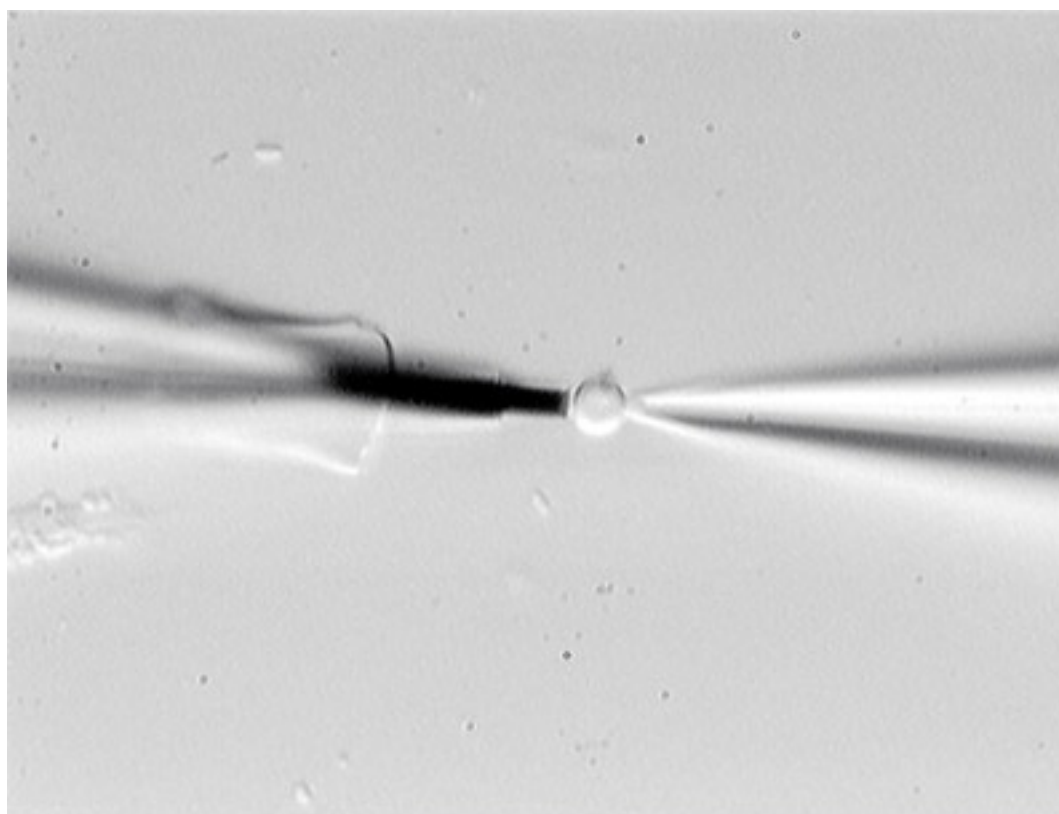


# The use of the Van den Hul low noise carbon fibers in brain research

H.D. Mansvelder, J.C. Lodder and K.S. Kits  
Department of Molecular and Cellular Neurobiology,  
Faculty of Biology, Vrije Universiteit Amsterdam.

The brain uses chemical compounds, called neurotransmitters, to convey messages from one cell to another. Many of these transmitters are oxidizable in a relatively low electrical field. When they are oxidized, the transmitter loses one or more electrons which can be detected by an electrode. In neurobiology, carbon fibers are used as an electrode to both generate a local electrical field, as well as to measure the electrons that are lost upon oxidation of neurotransmitters. This can be done for large groups of cells, where the ensemble release of transmitters from these cells is measured. However, by using equipment and materials with the lowest noise characteristics, it is possible to detect the release of transmitters from one cell, and even the content of one granule in which the cell packaged the transmitter molecules. In this way, the release of only 5 to 10 thousand molecules from one granule can be detected.

In our neurobiology department at the Vrije Universiteit in Amsterdam, we use the Van den Hul carbon fibers for electrochemical detection of released compounds from single brain cells, because of their very low noise characteristics. The oxidation currents we measure range from ~150 pA down to 1 or 2 pA, hence we need the noise to be below 0.5 pA rms. at 1 kHz bandwidth. The Van den Hul fibers give us just that (\*).



The Figure shows a brain cell with two electrodes attached to it. One makes an electrical recording from the cell, the other (black) detects, by oxidization, compounds that are released from the cell. The electrodes were made in our laboratory and the black bar is the Van den Hul carbon fiber. The fiber diameter is 6  $\mu\text{m}$ , just somewhat smaller than the cell diameter. Only the tip of the fiber is sensitive to oxidizable compounds, the rest of the fiber is covered by insulating materials.

Further reading: R.H. Chow and L. von Rüden. Electrochemical detection of secretion from single cells. In: Single-channel recording (2nd edition). B. Sakmann and E. Neher eds. Plenum Press, New York.

(\*): To minimize the noise contribution of the carbon fiber electrode to the total noise in the measurement setup, the electrode needs to have an as low as possible electrical resistance. There exist many types of thin carbon fibers, the Van den Hul carbon fibers however have been specially designed bearing electrical signal conduction in mind and exhibit a very low resistance. They furthermore have the right diameter and are strong (i.e. they don't break easily).

The Van den Hul carbon fibers used here have been extracted from a short sample of Van den Hul's CC - 18 type single lead insulated Linear Structured Carbon<sup>®</sup> wire which contains 12,000 individually insulated fibers. It is cheap and the insulation can easily be removed by means of rinsing the extracted fibers in pure Propanone = Acetone. —**A.J. van den Hul B.V.**

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