Micro-Imaging with a Glass-coated Electrode Array

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In this paper, we present preliminary results of work directed at exploiting a sensor array originally developed for fingerprint acquisition [1]. In its chemical applications, we refer to it as the "Chem-Array" chip. The Chem-Array consists of a 256 x 364 matrix of capacitors on a platform 13 x 18 mm, about the size of a postage stamp. Each pixel is 50 µm square. The capacitor electrodes are passivated by layers of inert material and have no physical contact with the sample. When the inert material is ordinary glass, a wide variety of chemistries are available for modifying the surface for service as a chemical or biological sensor.

For aqueous chemical applications, the sensor appears to respond mainly to the electrical conductivity of the analyte within a few microns of the surface. For example, we have reported that pollen grains, which are nonconductive, can be imaged against a background of dilute salt solution and glycerol (which prevents the aqueous layer from drying) [1]. Similarly, a monolayer of chicken embryo heart cells is clearly seen (Figure 1), and it is possible that we may be able to image the electrical activity of these cells in addition to their physical motion while beating.

We have calibrated the array to salt solutions in order to determine the effect of varying its operating parameters. Linear performance seems to be available between 0.001 M and 0.1 M KCL, and includes the physiological range.

Larger organisms, such as the 0.5 mm nematode *Steinernema carpocapsae*, are also readily seen on the array (Figure 2). The detection of parasites and other medium-sized organisms will be simplified by the Chem-Array.

Figure 1. Biofilm of embryonic chicken heart cells.

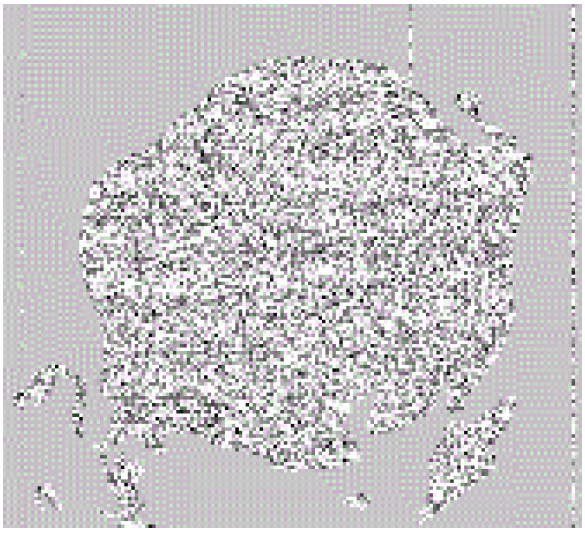
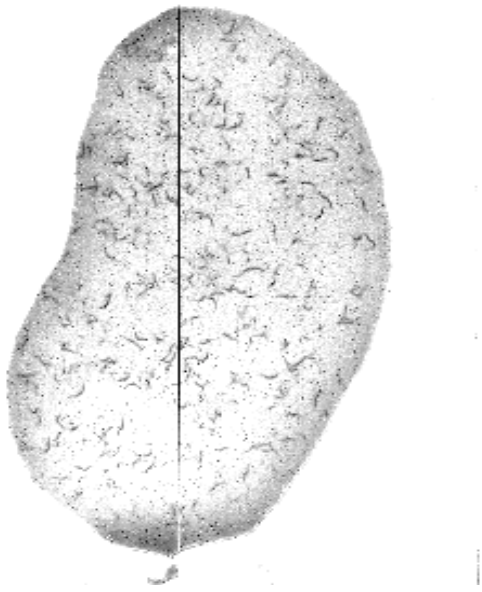


Figure 2. Nematode Steinernema carpocapsae in distilled water on the sensing chip.



References

[1] J.R. Stetter, U. Göpel, W.R. Penrose, and L. Manno, 2001. Impedance imaging of chemical and biochemical systems. Proc. 11th Annual Conf. Solid-State Sensors and Actuators, Munich, Germany, June 10-14, 2001. Ed.: E. Obermeyer, pp. 810-813.