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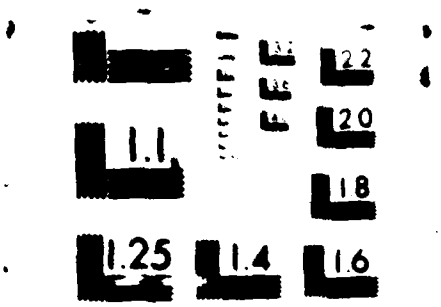
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STOCHASTIC PROCESSES IN CHEMFETS
(Final Report, January 1987)

Contract Number NOOO14-81-0664
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The methodology for evaluation of the electrochemical parameters of both equilibrium and non-equilibrium processes using fluctuation analysis has been fully developed. Paper describing the basic aspects of this technique in a tutorial form has been submitted to Analytical Chemistry as an A-page article in hope that the new technique will find broader application within the electrochemical community. As a corollary to this work we have studied the diffusional impedance of disk and ring microelectrodes and developed theory for the Warburg impedance of these electrodes.

Work on chemically modified suspended gate field effect transistor has continued very successfuily. We have been able to incorporate nitroarene moieties into polypyrrole and thus create an organic semiconductor with selectivity to arenes. A close collaboration on this project with the Institut für Physik, Universität der Bundeswehr München continues.

Design of improved top passivation layers for chemical sensors began in January, when Dr. C. DeSequeira joined our group. He started on deposition and characterisation of thin silicon carbide films.

Fabrication and preliminary testing of the first hole-in-the-rock FETs has been completed. The initial results indicate that this may be a valid technique for study of channel insulators in FET structures.

SIGNIFICANT RESULTS

The most significant result of the stochastic analysis part is the development of complete methodology for determination of basic electrochemical parameters (heterogeneous rate constant, double layer capacitance and diffusion coefficient) from truly equilibrium measurements. The method is applicable to a wide range of electrochemical reactions.

The ability to monitor directly the corrosion of insulators using field effect transistors has been demonstrated. This technique will serve as the basis of the methodology for development of new, more

resistant encapsulation materials, particularly for integrated solid state sensors.

The observation and subsequent theoretical justification of the fact that microelectrodes create a radial diffusional field even at equilibrium has been surprising. It may have significant implications for quantification of the signal transmission in biological systems, such as synaptic junctions.

The co-polymerization of pyrrole with nitrotoluenes has resulted in a new conducting polymer which exhibits a selective (H-π and π-π) interaction with gaseous arenes. Such interaction is absent in pure polypyrrole. We believe that this is the first case of rationally designed chemically selective layer in which the analyte/substrate interaction could be a priori predicted. The new material has unusually high electron work function as compared to ordinary polypyrrole. It is easily deposited onto the suspended metal gate of our new field effect transistor which again confirms our contention that this is a new generic type of gas sensor.

A similar structure with the gate insulator partially removed (hole-in-the-rock) has been made and tested for basic transistor behavior. It has been found that below certain minimum insulator thickness (~50Å) the density of interface states becomes so high that the Fermi level is pinned and the surface charge density cannot be modulated by externally applied field. However, possible chemical modifications of the insulator within this structure could be used as the tool of study of improvement of the performance of thin-gate-insulator transistors.

PERSONNEL

1.	Andras Bezegh	noise analysis
2.	Mira Josowicz	gas sensors
3.	Max Levy	device and materials preparation
4.	Cesar DeSequeira	materials preparation

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