Paramagnetic Doping of DNA Forms Spin Lattice Films

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Projections :

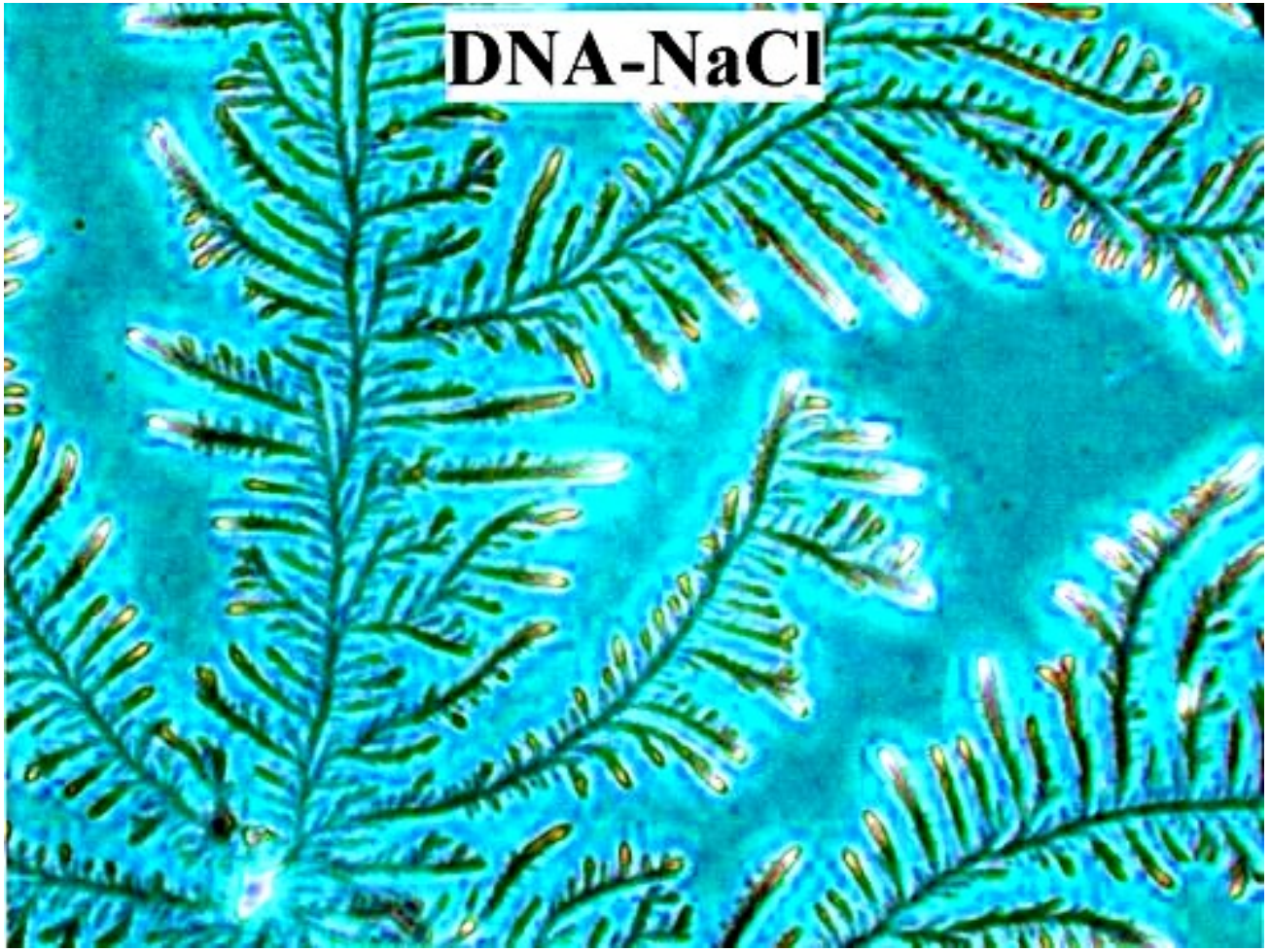
Oxygen deficit occurs in cancer and also in ischemic injury to the nervous system.

The electron transport chain of the mitochondria demonstrates that both oxygen and electron transfers in the living state are synchronous. Therefore models of disease based on oxygen deficit should also be considered as deficient in electron transfer.

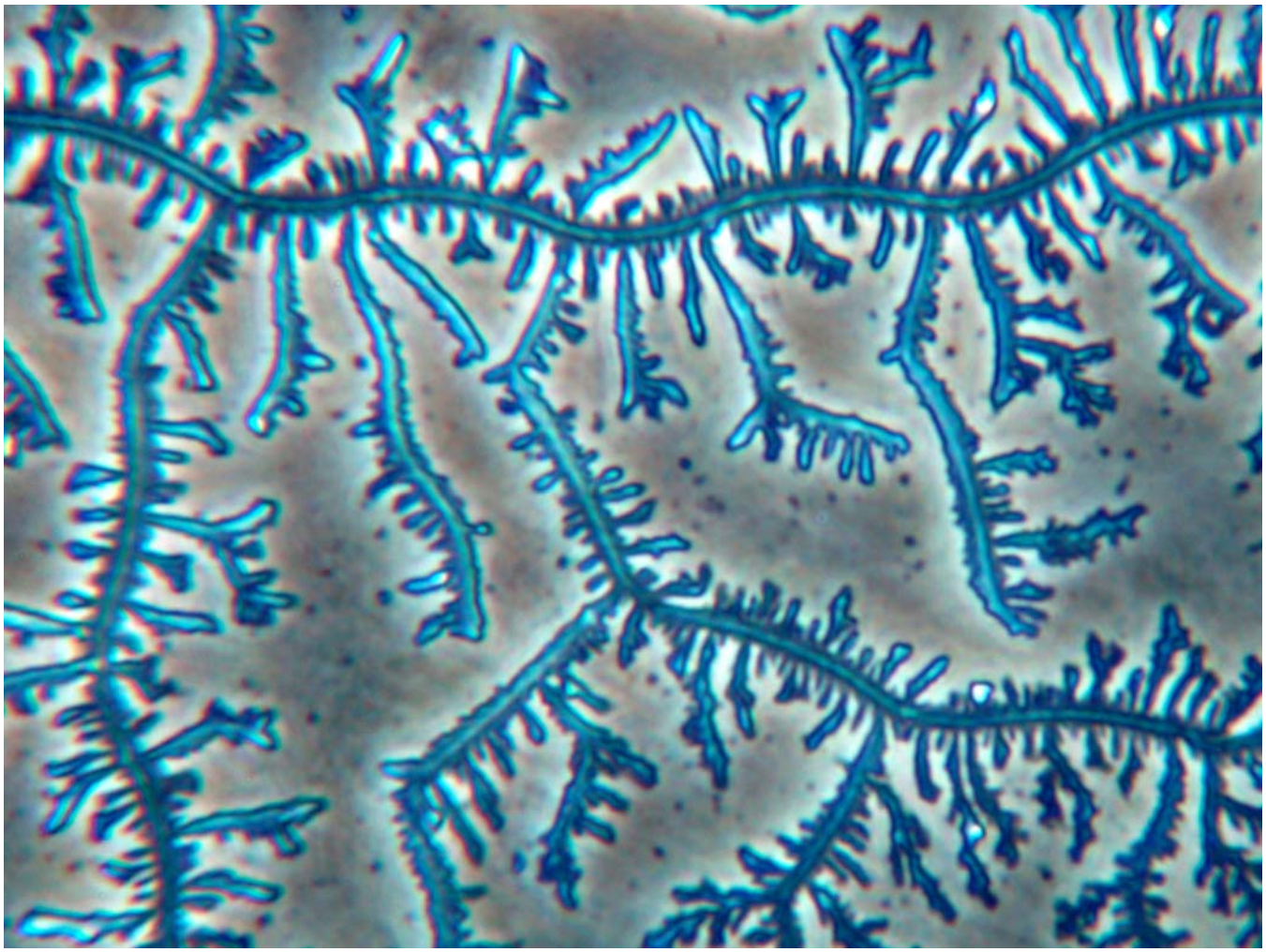
Efficient electron transfer in the solid state derives from the crystal order of the system. We observed liquid crystal order in biological polymers, but the view of liquid crystals as a possible basis for signals is novel in Biochemistry circles.

So – we persevered :

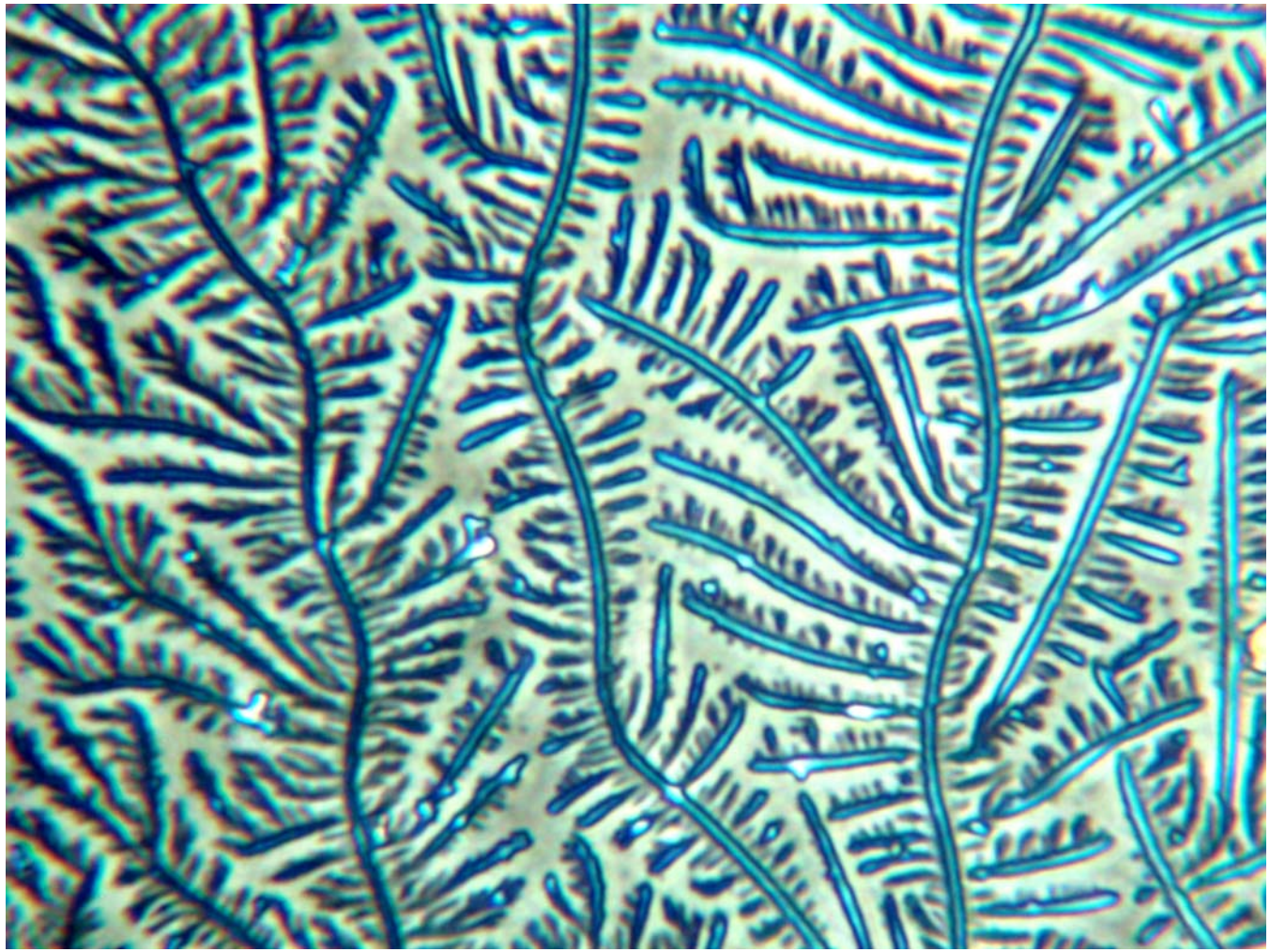
Calf thymus DNA in 0.1 M NaCl : A liquid crystal lattice



DNA + NaCl + H_2O_2 :
A lattice with a waveform



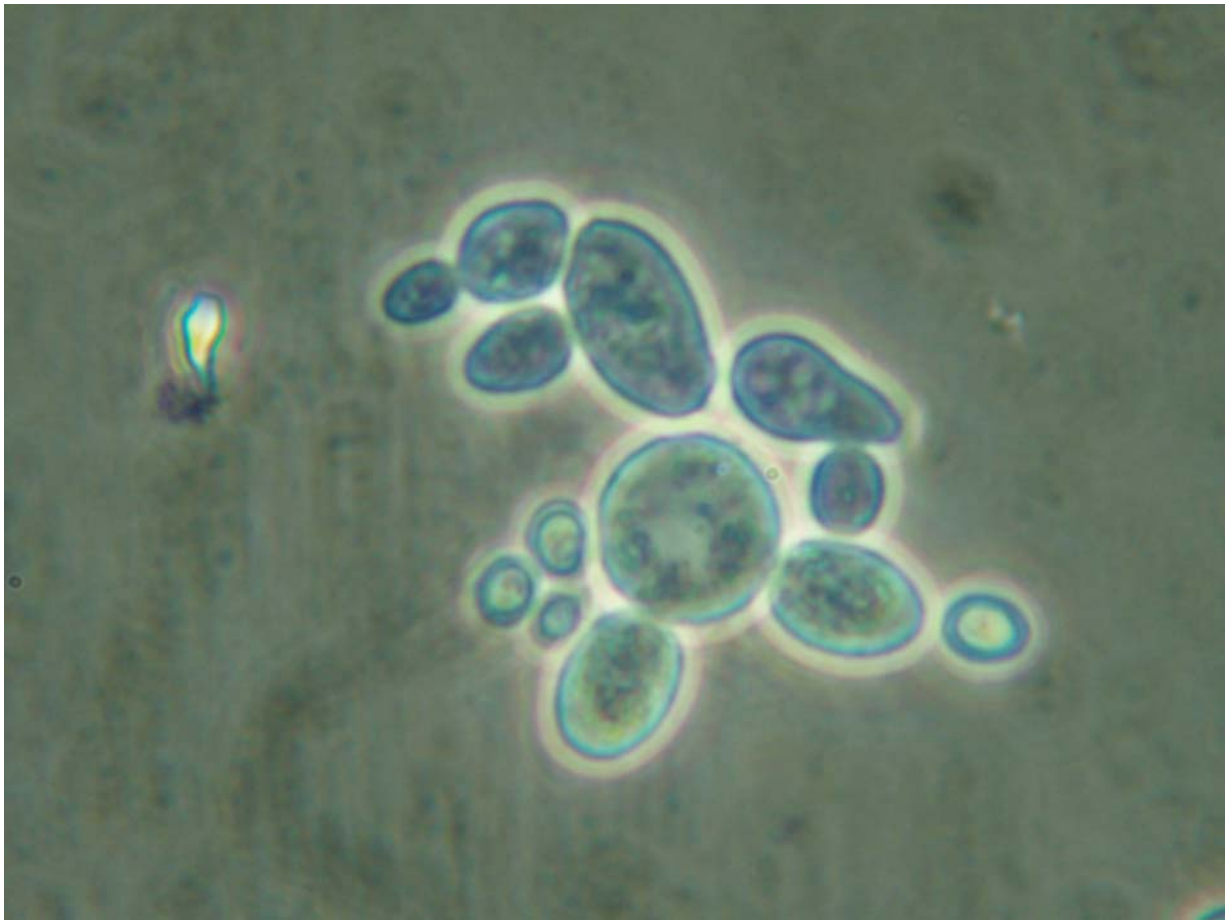
DNA + NaCl + palladium-lipoic acid : A lattice with a waveform



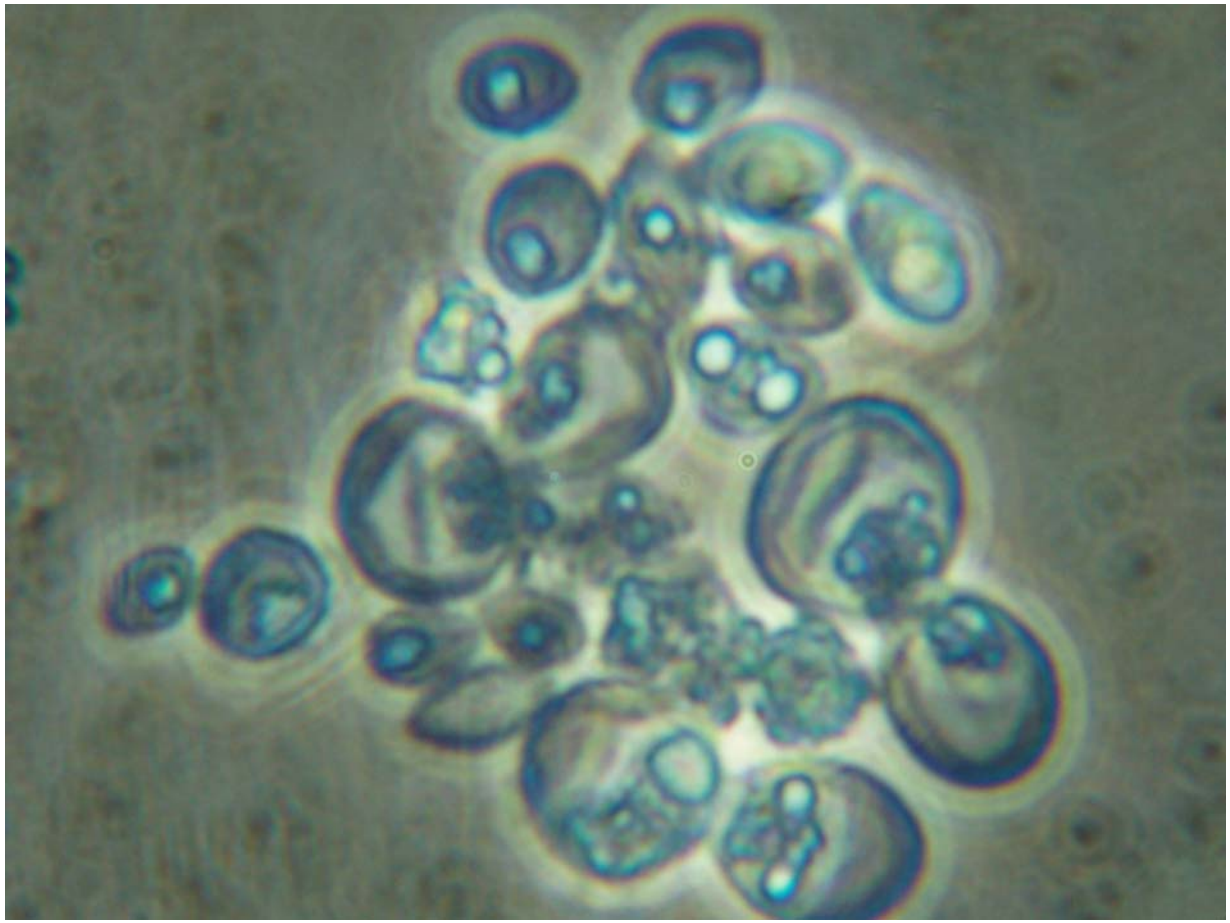
Paramagnetic dopant induction of waveforms in liquid crystal DNA introduces questions :

1. ***Are these coherent Bloch waves which function over long distance ?***
2. ***Are there rapid wave signals ?***
3. ***What happens in the double layer ?***
4. ***What are the effects on cells ?***

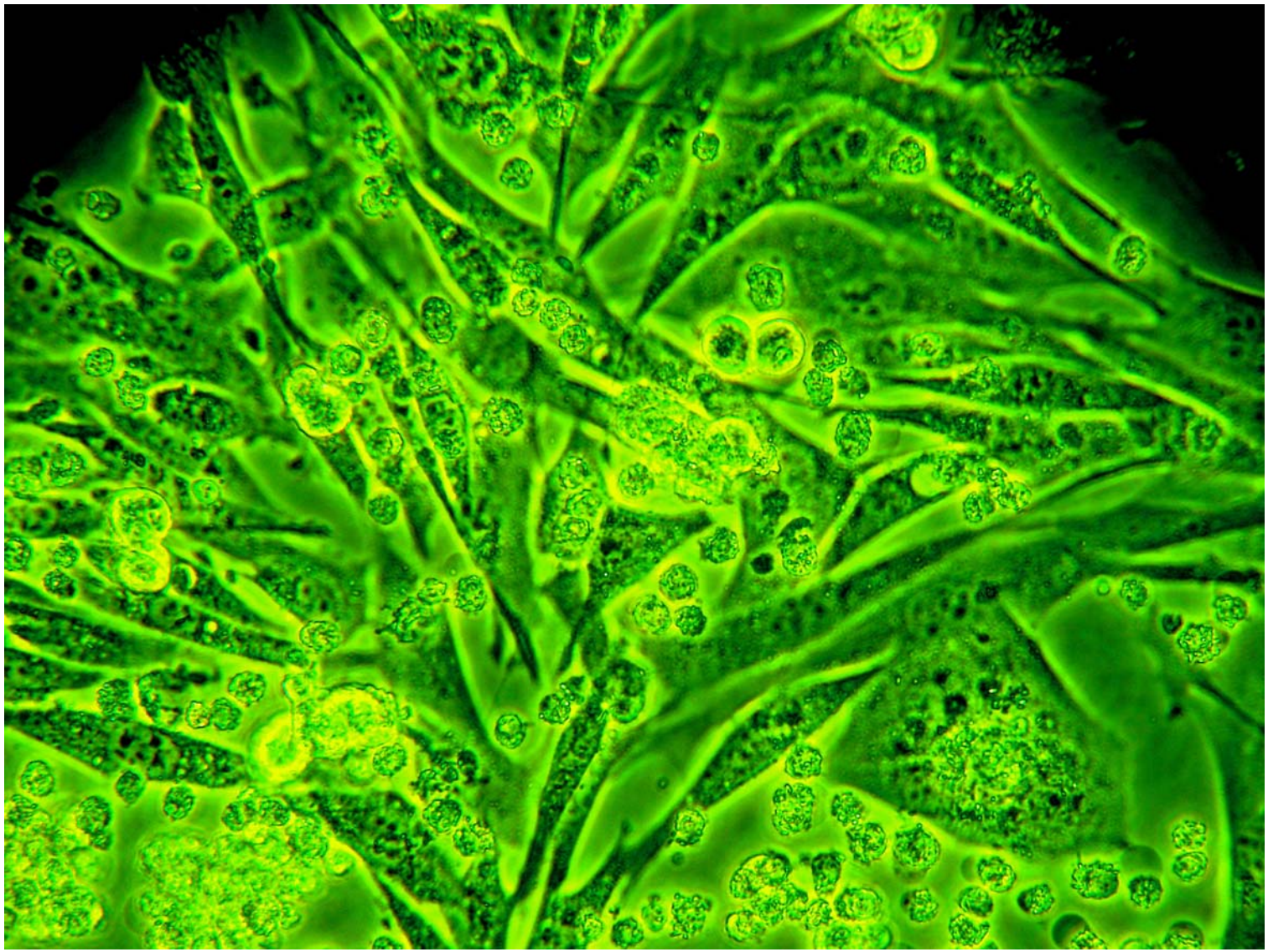
Normal Bakers' Yeast -



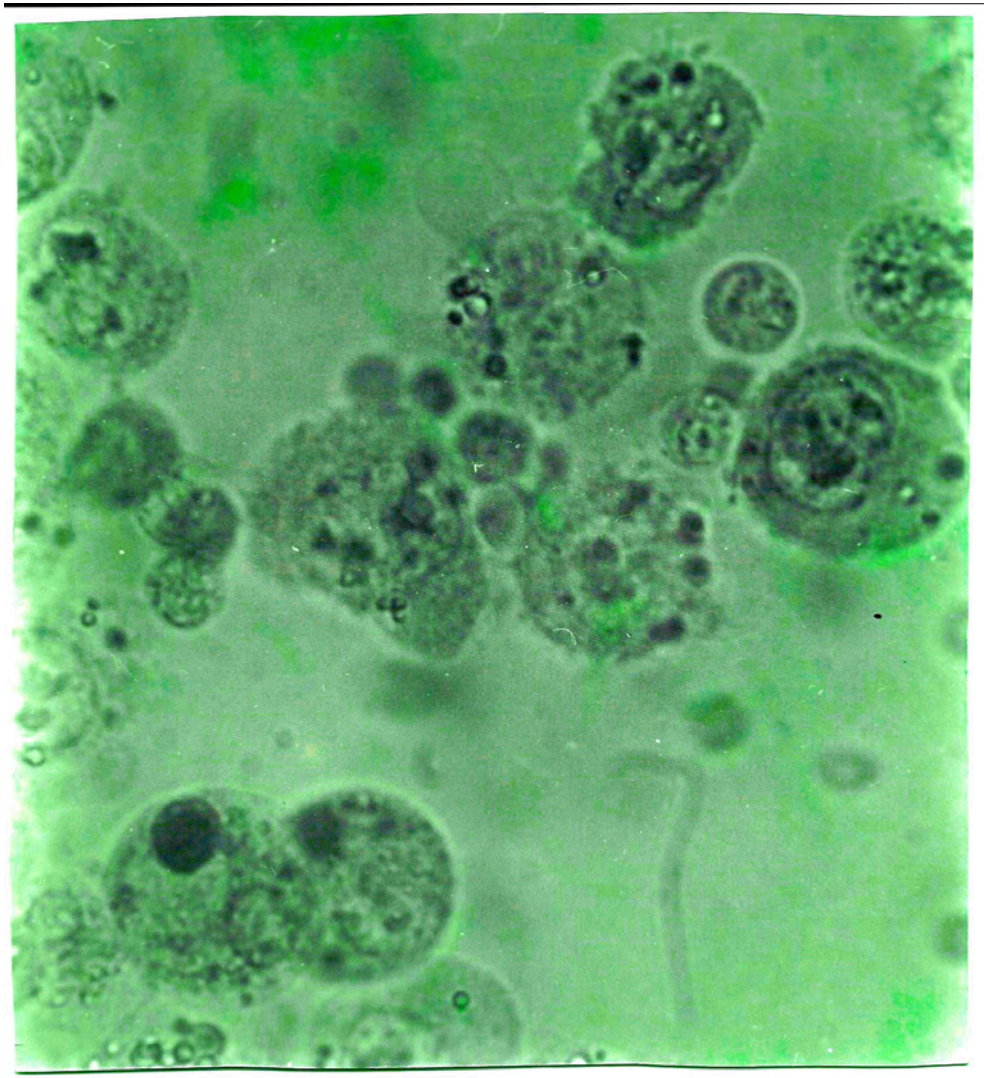
Palladium-lipoic acid condenses chromatin in Bakers' yeast -



Ehrlich carcinoma monolayer culture -

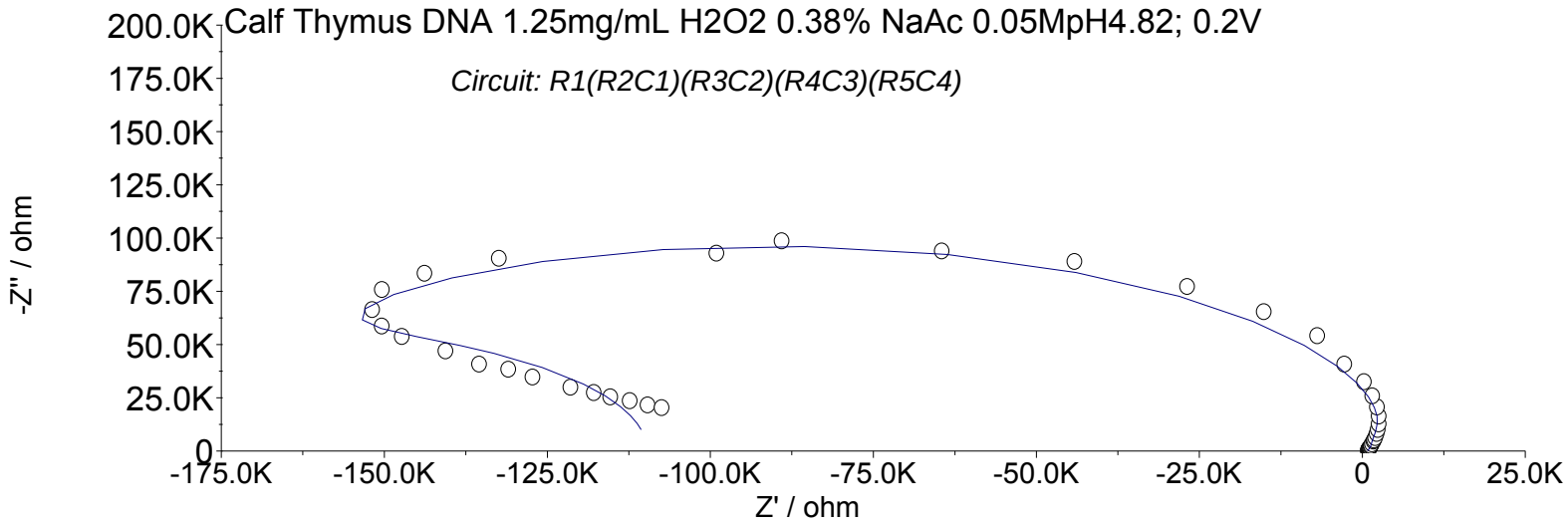


Ehrlich carcinoma undergoes chromatin condensation and cell degeneration from Pd-lipoic acid.



Pd-lipoic acid is a fern type liquid crystal –
The surfaces are infinitely folded -
The double layers must be redundant.

Peroxide doped DNA produces negative differential resistance



Baseline for Negative Resistance

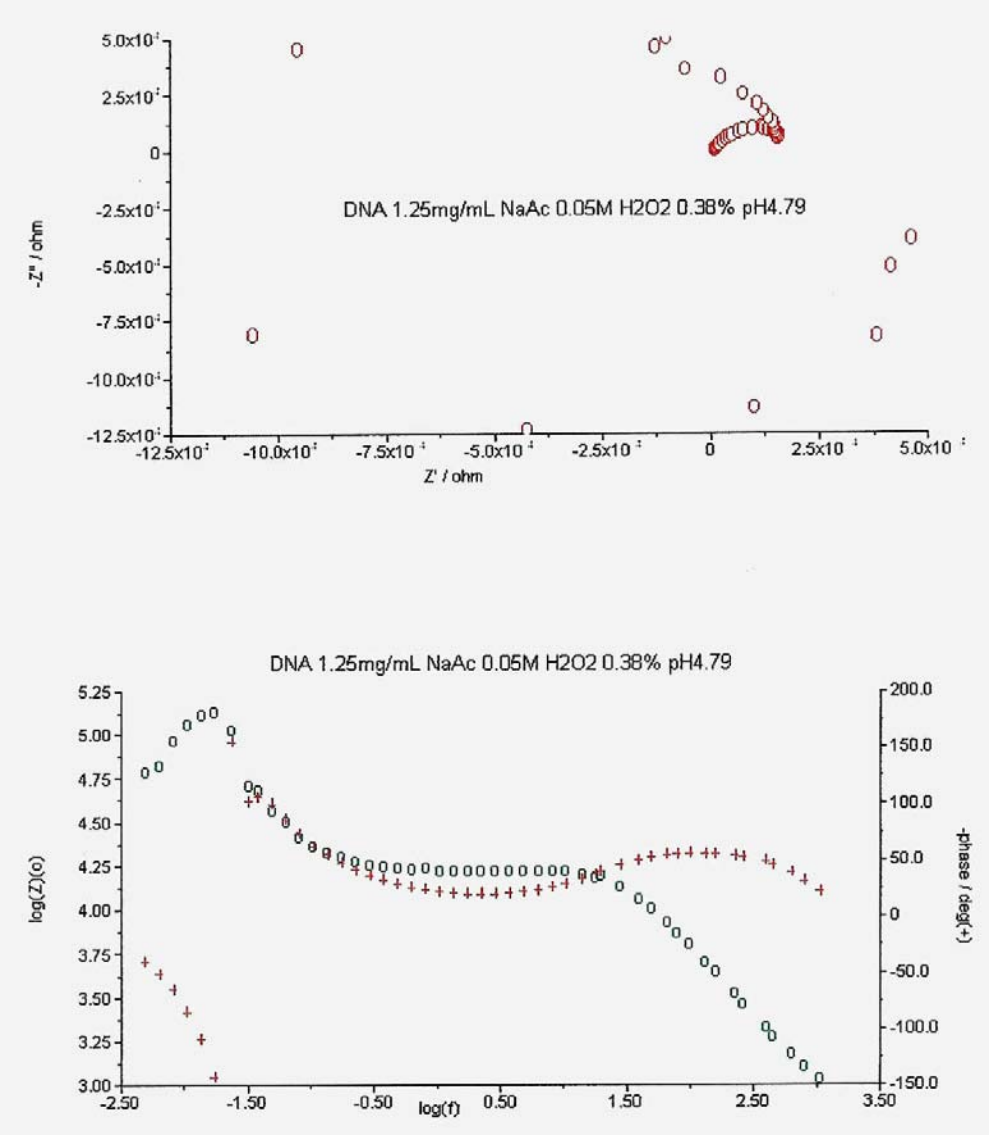
- Notice the reversing impedance curve of a conducting polymer first requires completion of the steady state curve.
- Curvilinear discharge tells us the electrons are in an organized structure.
- This structure is the Secondary (Type 2)

Polarization parallel to the polymer surface.

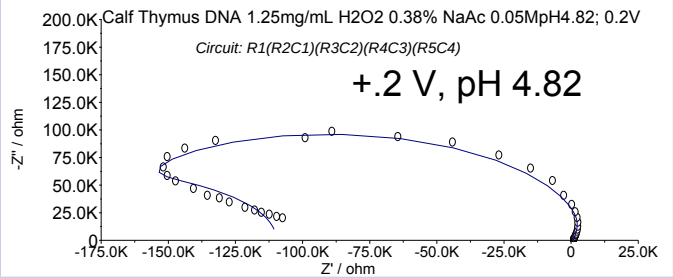
: This has been called hyper-polarization.

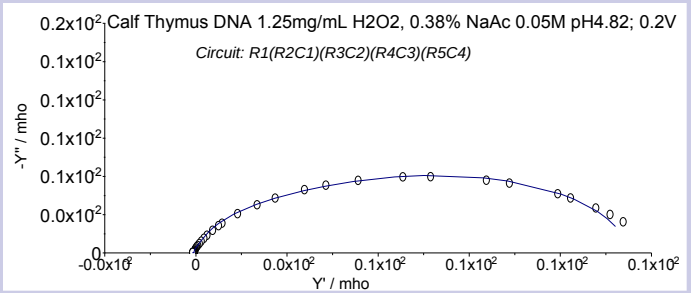
The paramagnetic species add new structure to the double layer.
Multi-quadrant impedance has been studied extensively
eg. Sadkowsky et al., also Krishnan,C.V. et al.

360º reverse impedance of DNA + H_2O_2

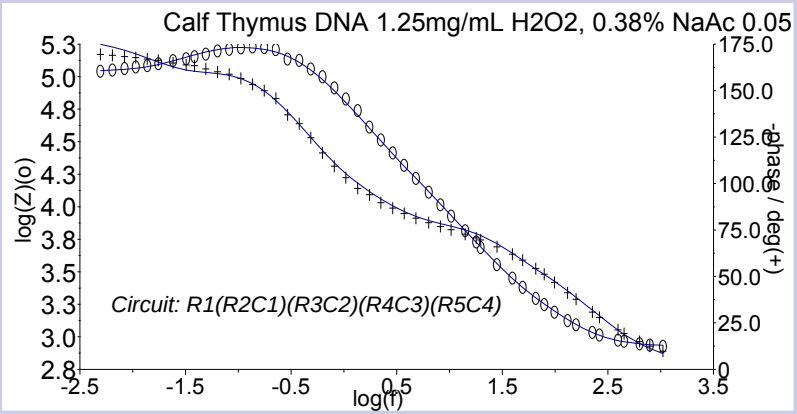


Equivalent Circuit DNA-H_2O_2-NaAc





Note the impedance enters the upper left quadrant



How can we measure DNA waveforms ?

answer : by an adaptation of

MOTT-SCHOTTKY IMPEDANCE

Mott-Schottky impedance measurements use a single frequency perturbation.

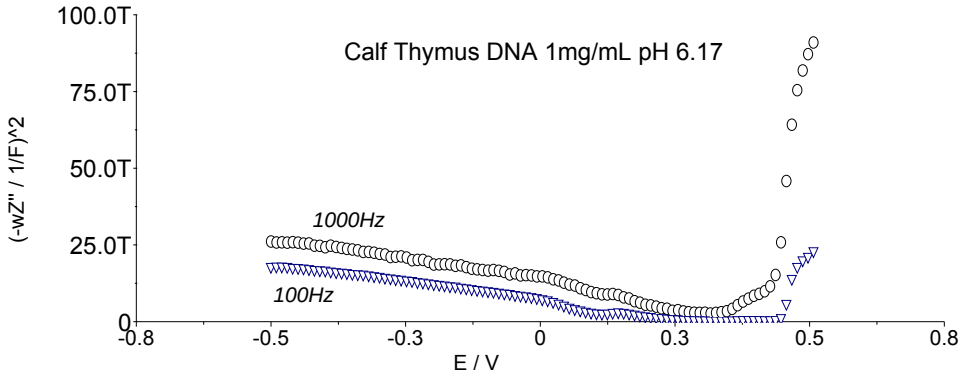
We find frequencies from 40-200 mHz. invoke DNA oscillation responses with a gold electrode.

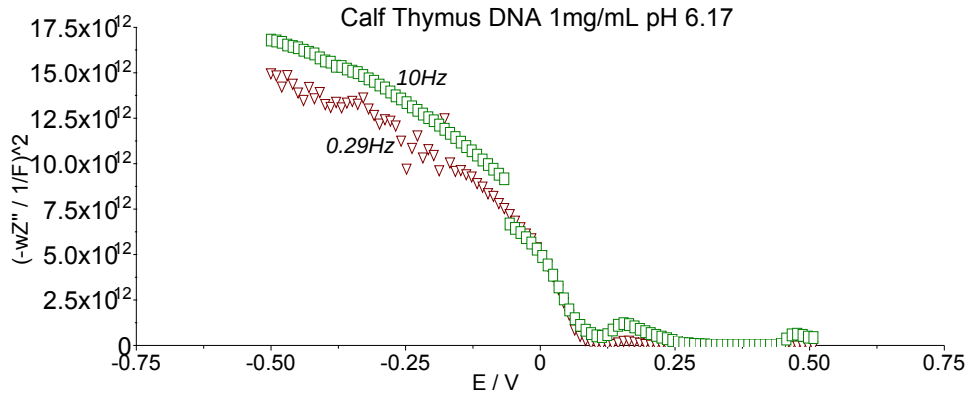
The sample is scanned through a voltage range with a choice of ordinates - including the usual $1/c^2$ plot which is used to find the slope of n or p type semi-conduction.

However a plot of inductance (L) provides a model for an interactive mechanism, namely mutual inductance. Also the admittance (Y) shows subtle dynamic details.

Mott Schottky plots for 1. mg/mL calf thymus DNA

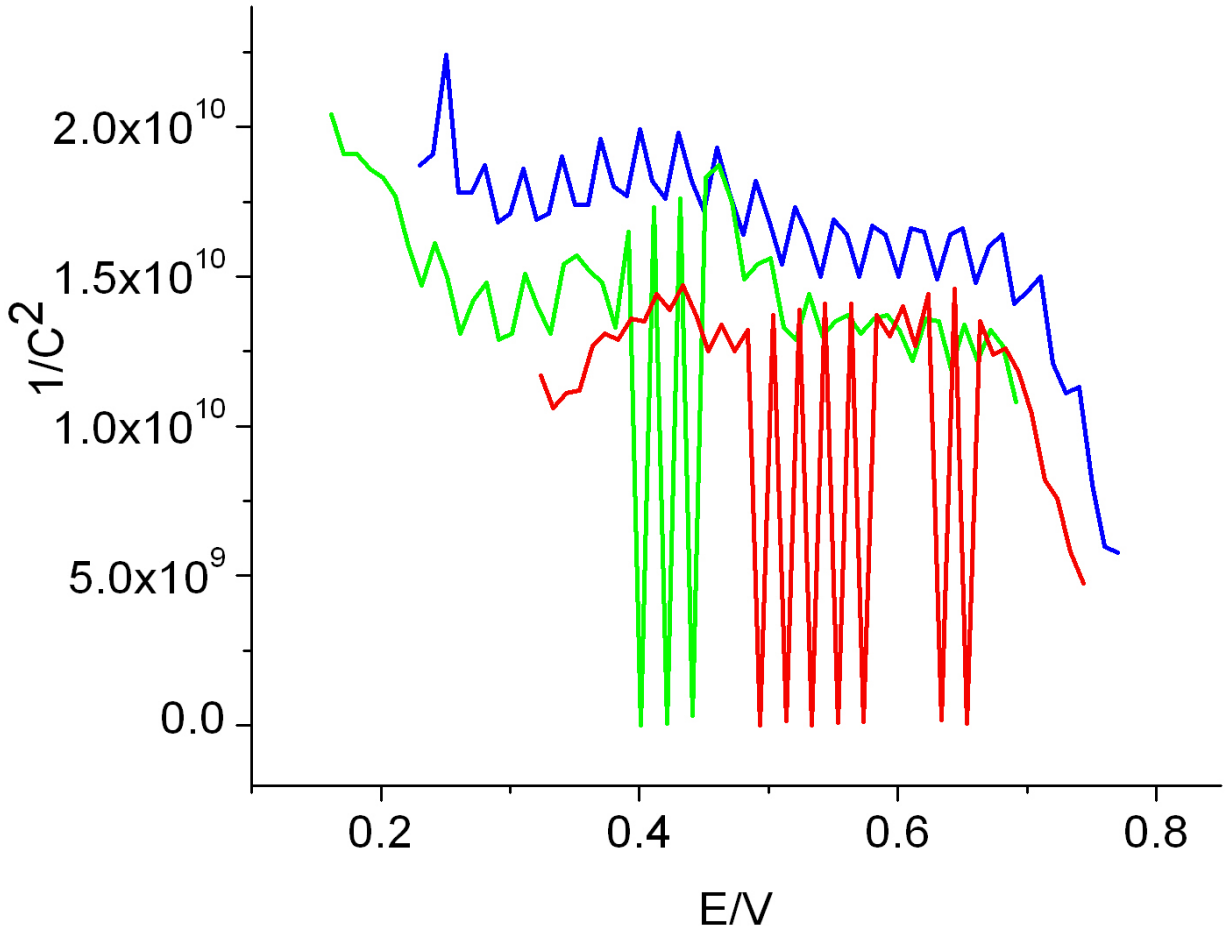
$1/C^2$





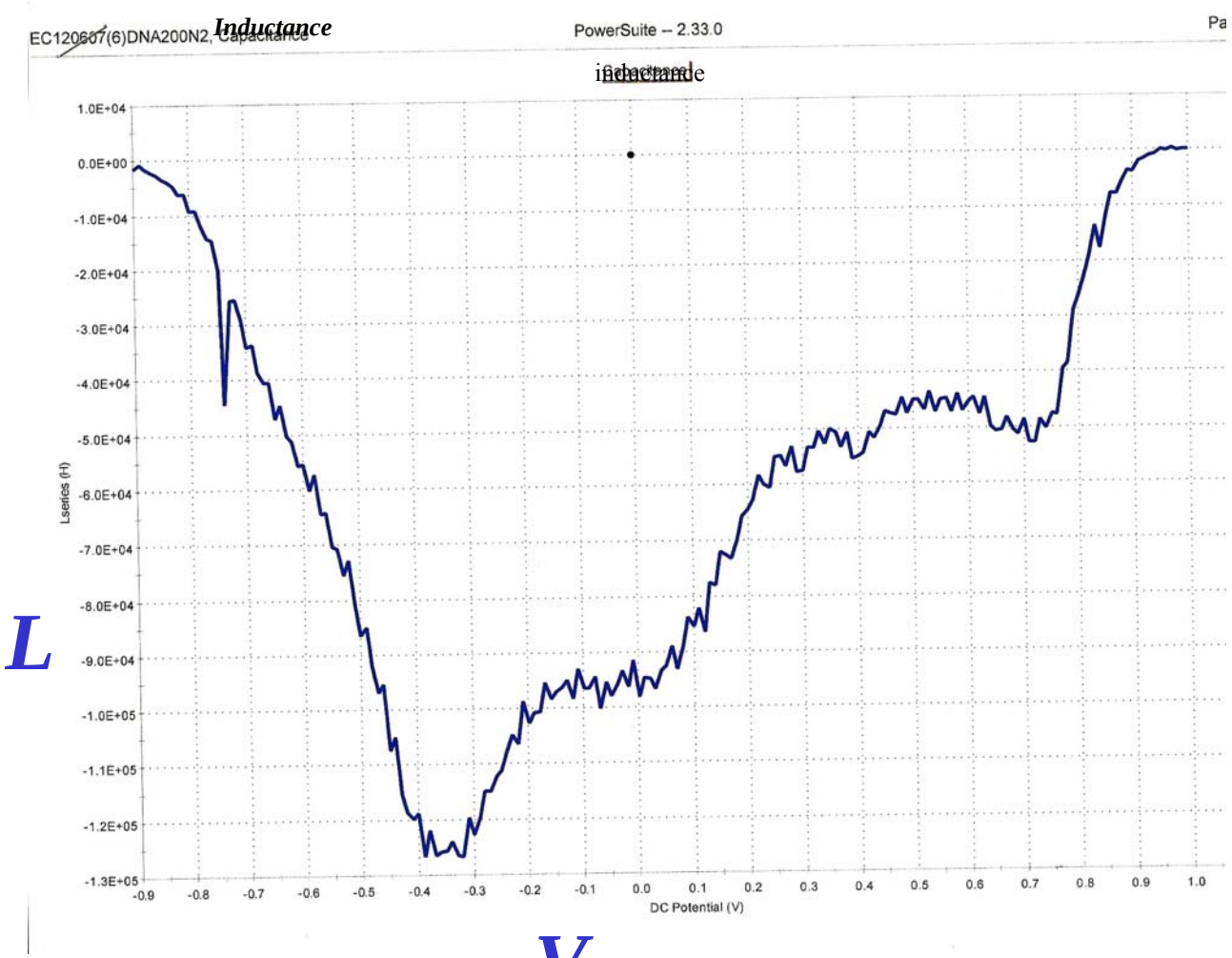
Steep incline in p slope from 10 Hz. and below.

Frequency sensitivity of DNA oscillations as $\underline{1/C^2}$ in air - Mott-Schottky: 100(blue), 60(green), and 40 mHz (red).



It became obvious that all atmospheric and electrolyte conditions were important to define DNA oscillation. Two different electrodes (Hg and Au) and two different atmospheres (aerobic and anaerobic) were employed. Sodium acetate, NaCl, and NaOH, were studied as background electrolytes.

Single frequency inductance scan @ 200 mHz. perturbation – DNA /NaCl/N_2 : shows fine oscillations

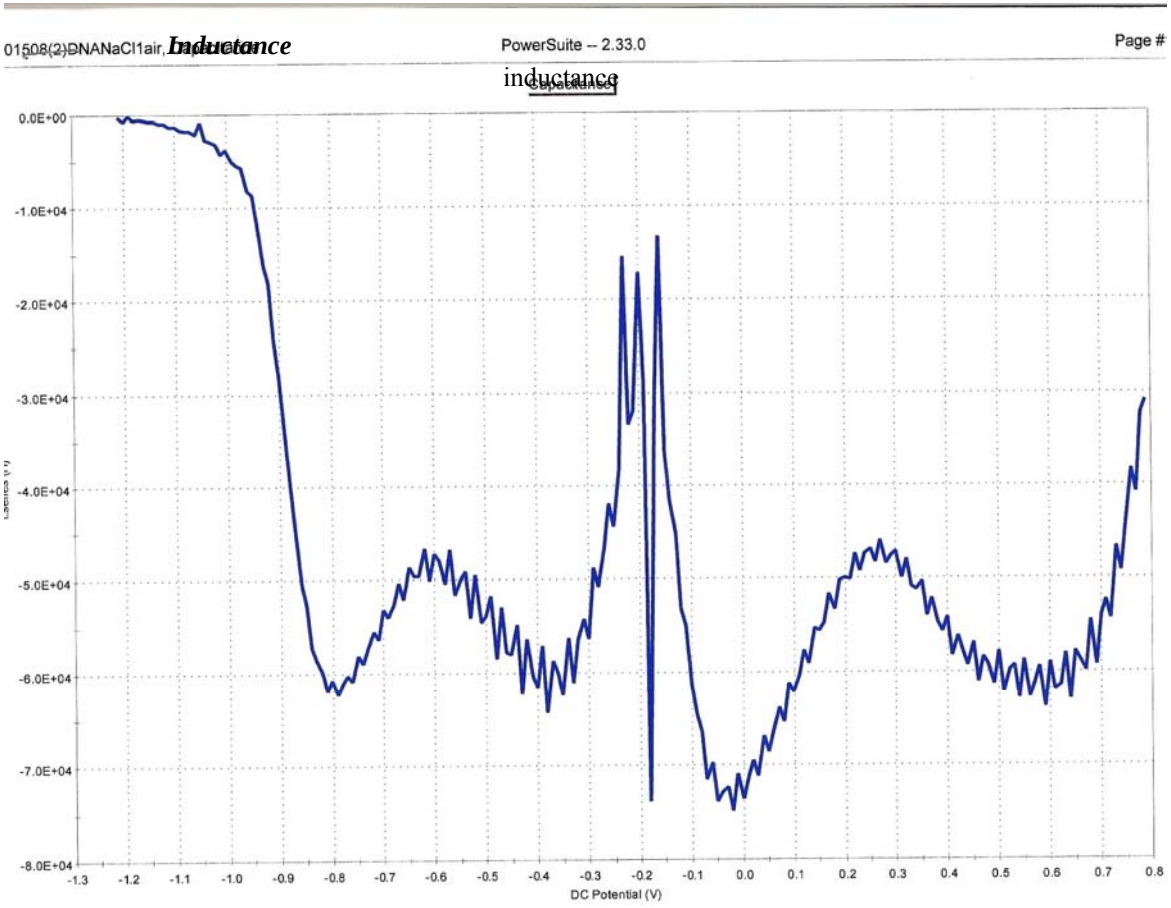


L

V

+

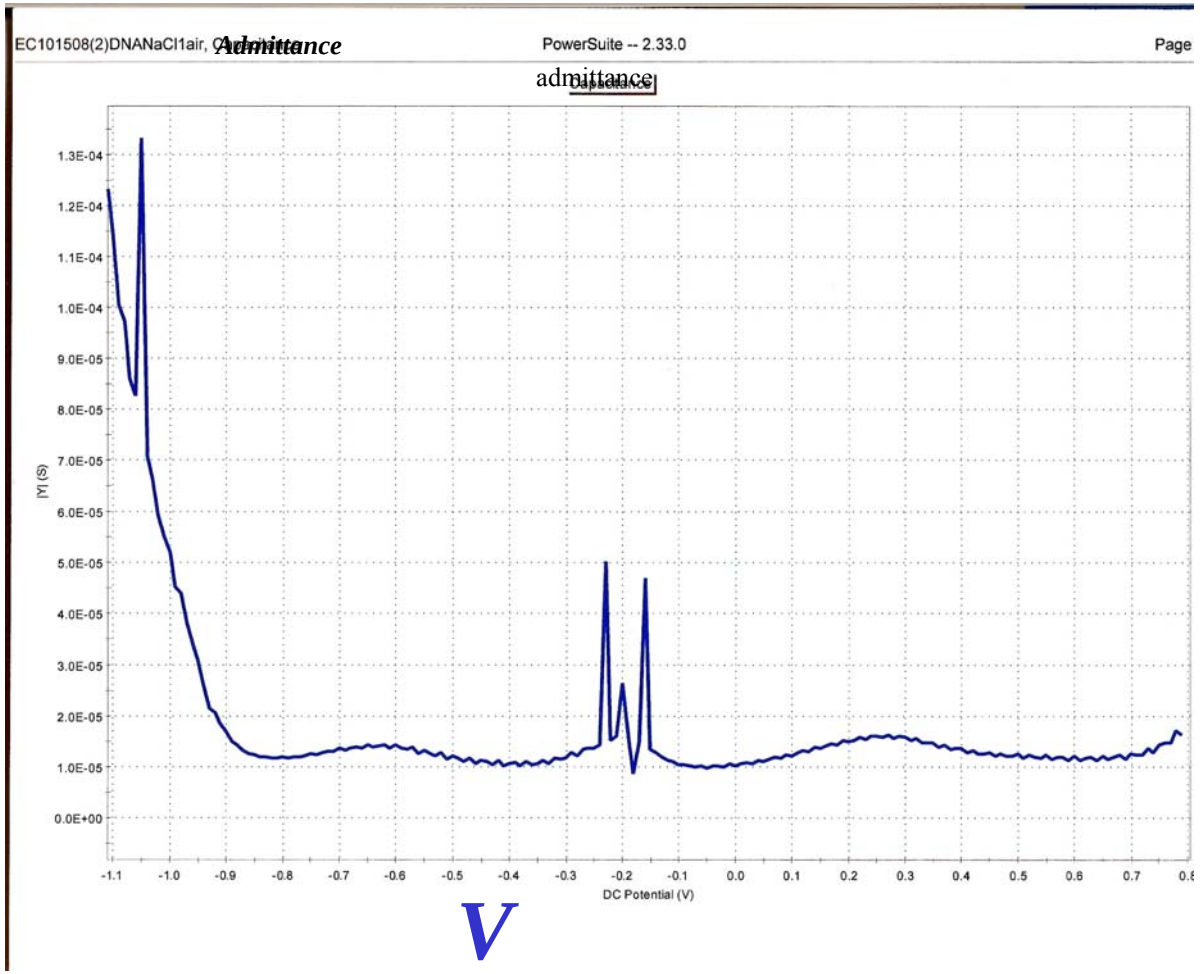
Single frequency inductance scan @ 200 mHz perturbation : DNA/NaCl (air) → inductance oscillation is strong around the oxygen potential (-.2 V)



L

V

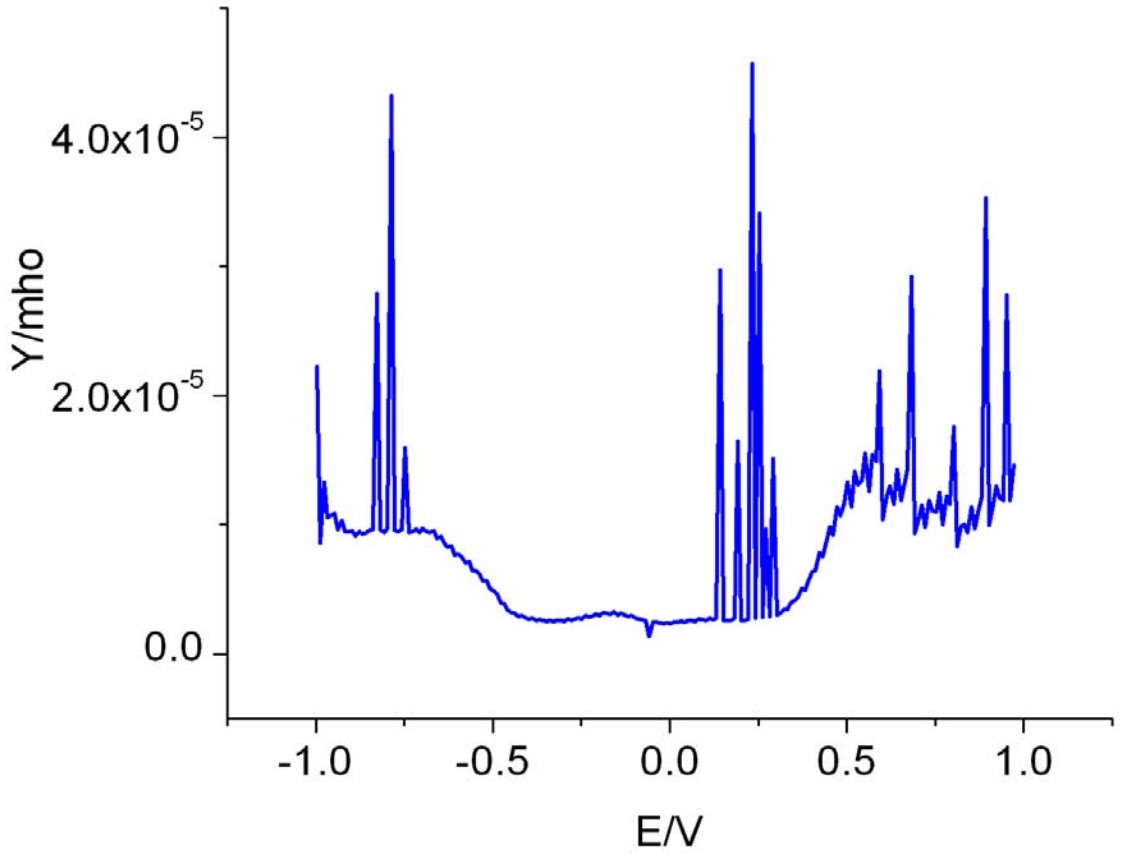
DNA/NaCl/air : Single frequency admittance scan



Y

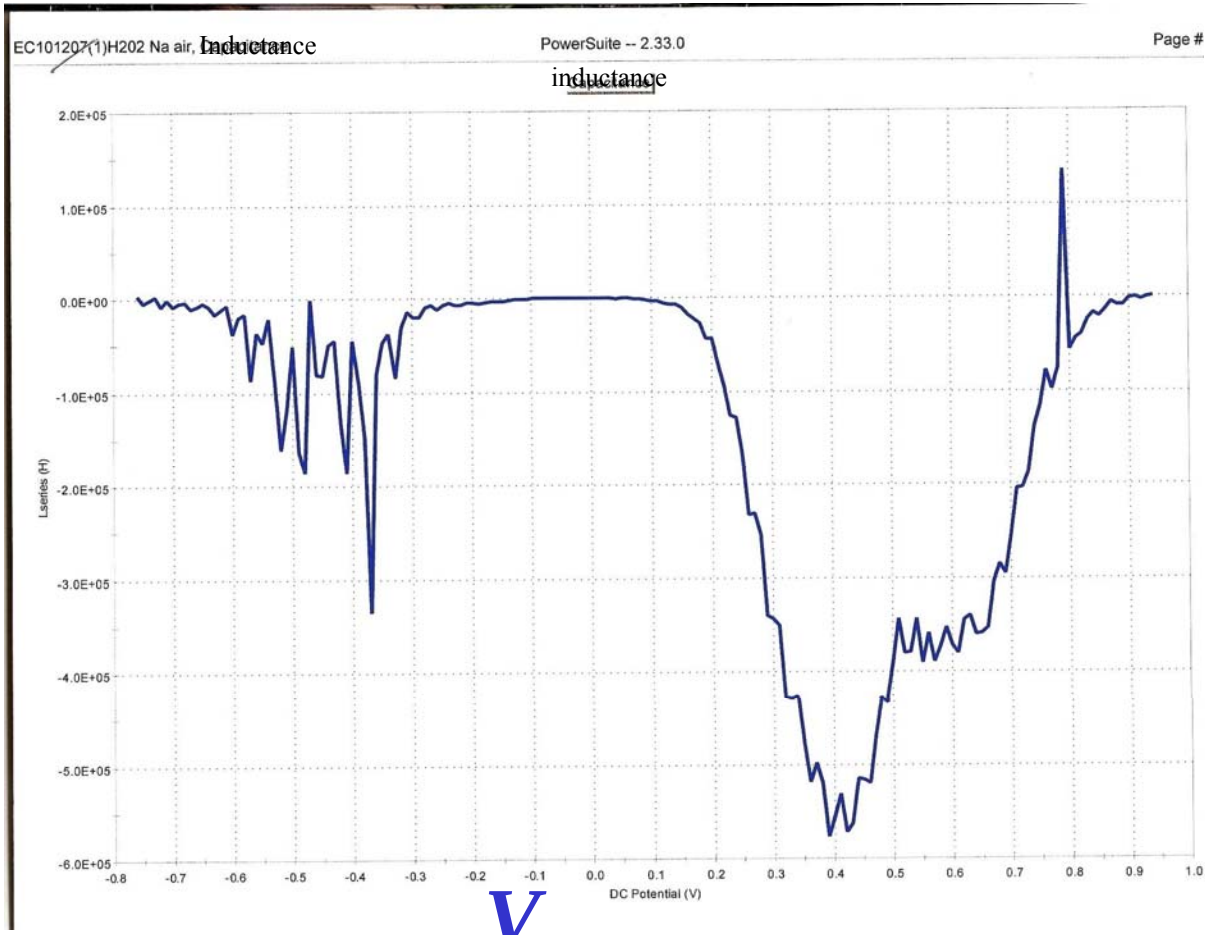
V

***DNA/NaOH/air* : Single frequency admittance scan: the absence of chloride enhances surface charge response.**



@ 60 mHz perturbation: single frequency inductance scan of H_2O_2/NaCl in air

→ large oscillation burst @ -.35 to -.6 V.

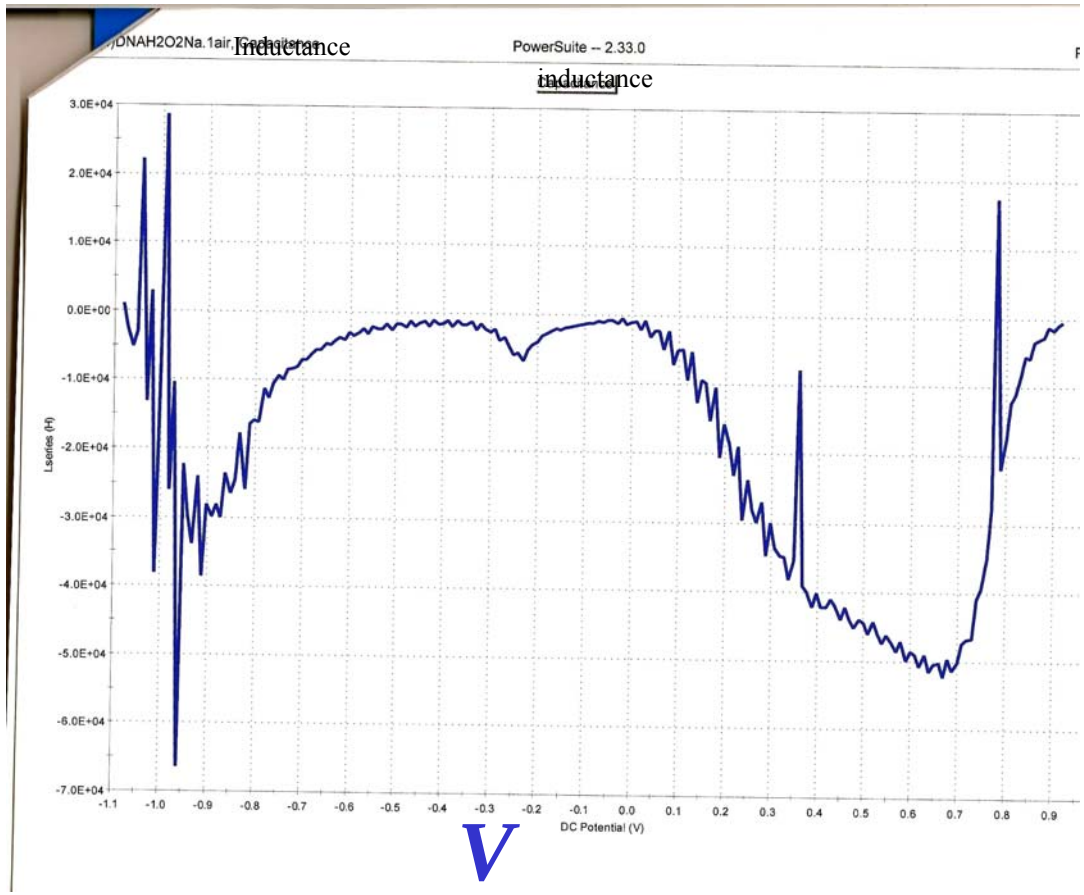


L

V

+

DNA/H_2O_2/NaCl/air : Single frequency inductance scan shows the oscillation zone shifts electronegative → -1.1 -.9 V.

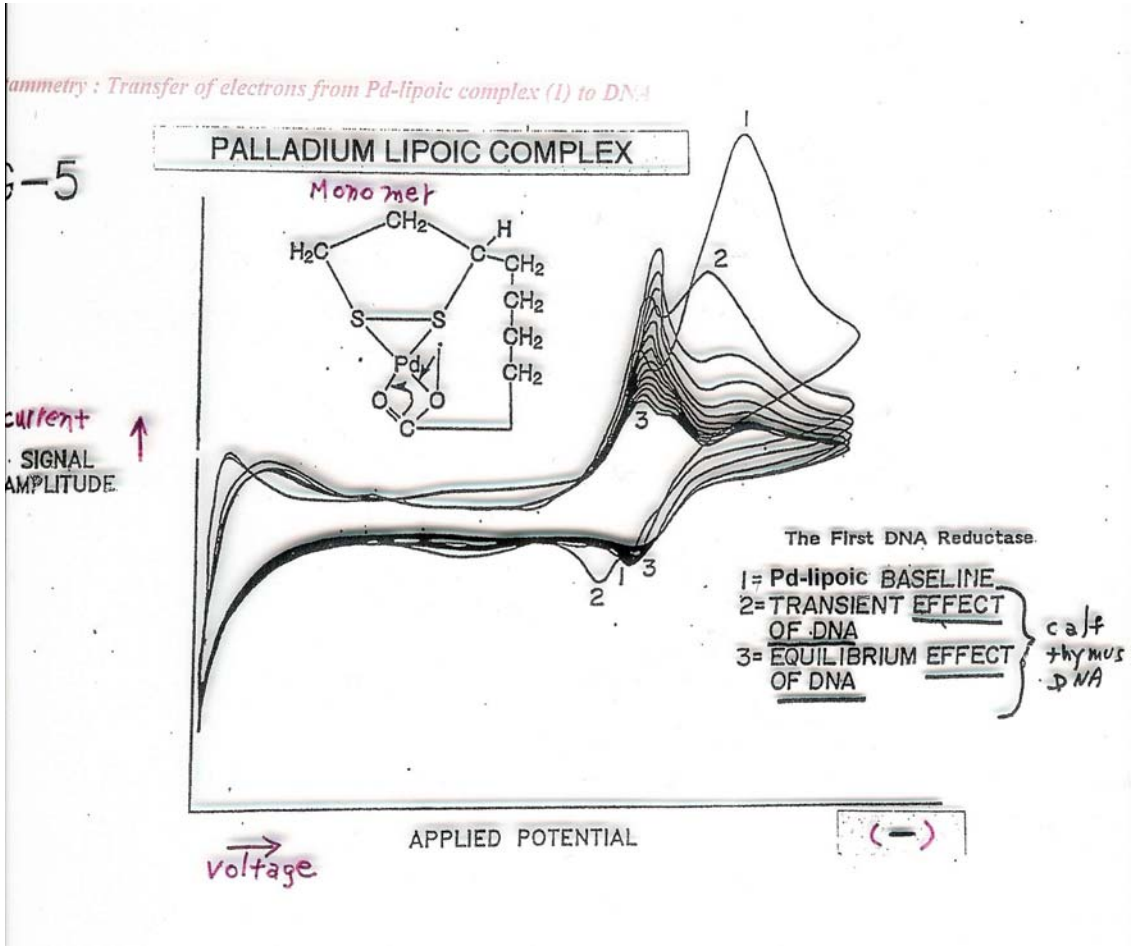


L

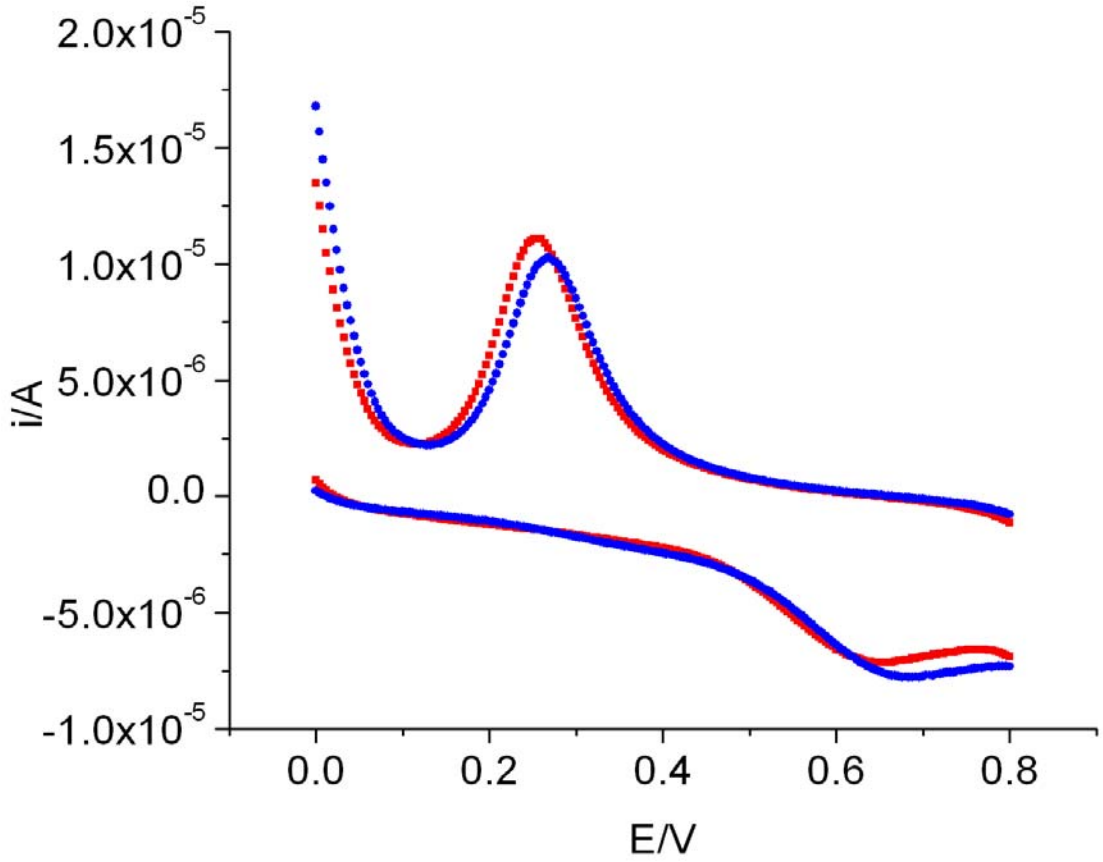
V

+

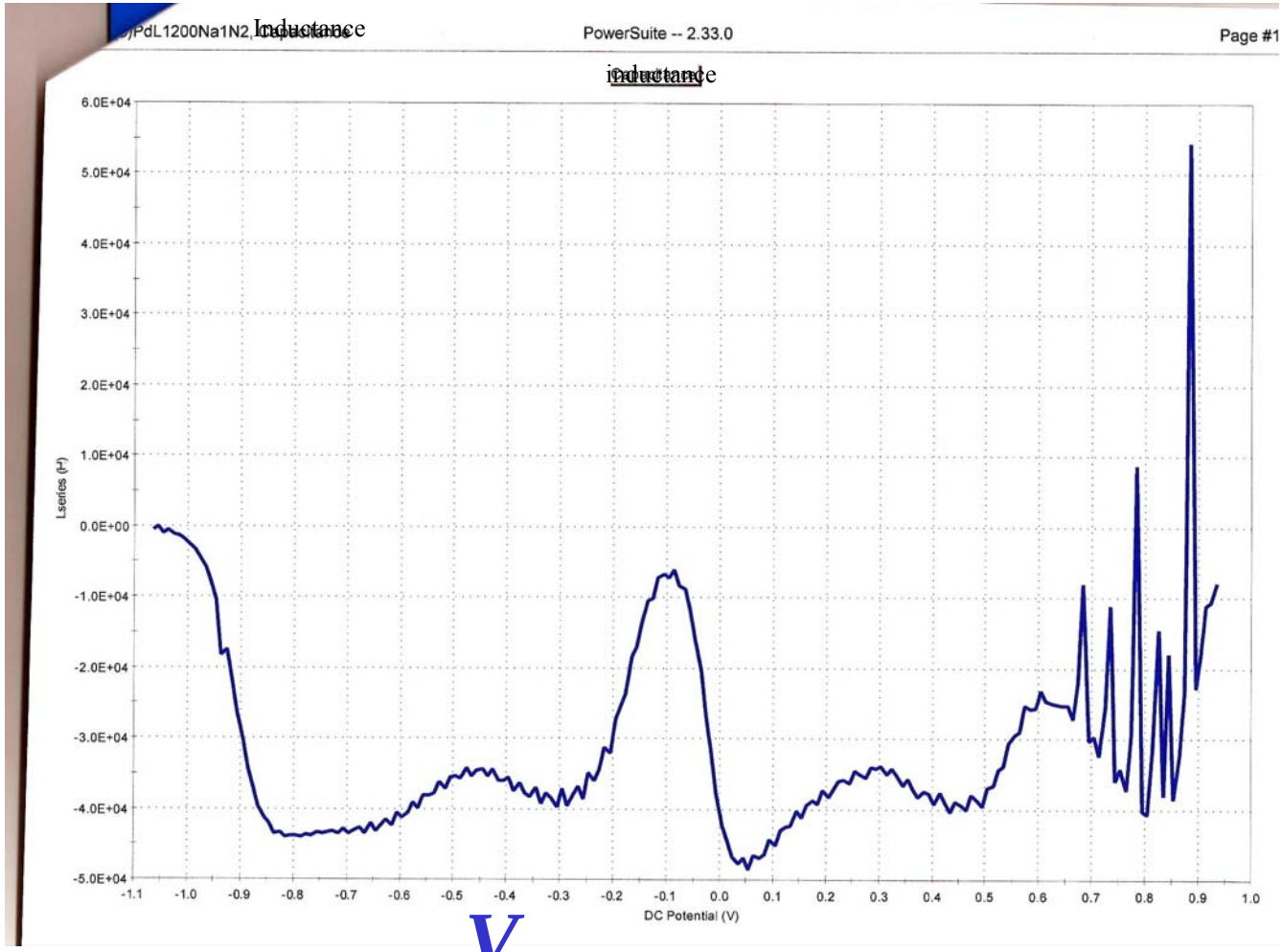
Voltammetric interaction of DNA and Pd-lipoic acid (Hg electrode/NaAc/N_2)



Voltammetric interaction of Pd-lipoic acid (red) and with DNA (blue) (Au electrode/NaAc/air)



Single frequency inductance scan – Pd-lipoic acid/NaCl/N_2 @ 200 mHz. : intrinsic oscillation

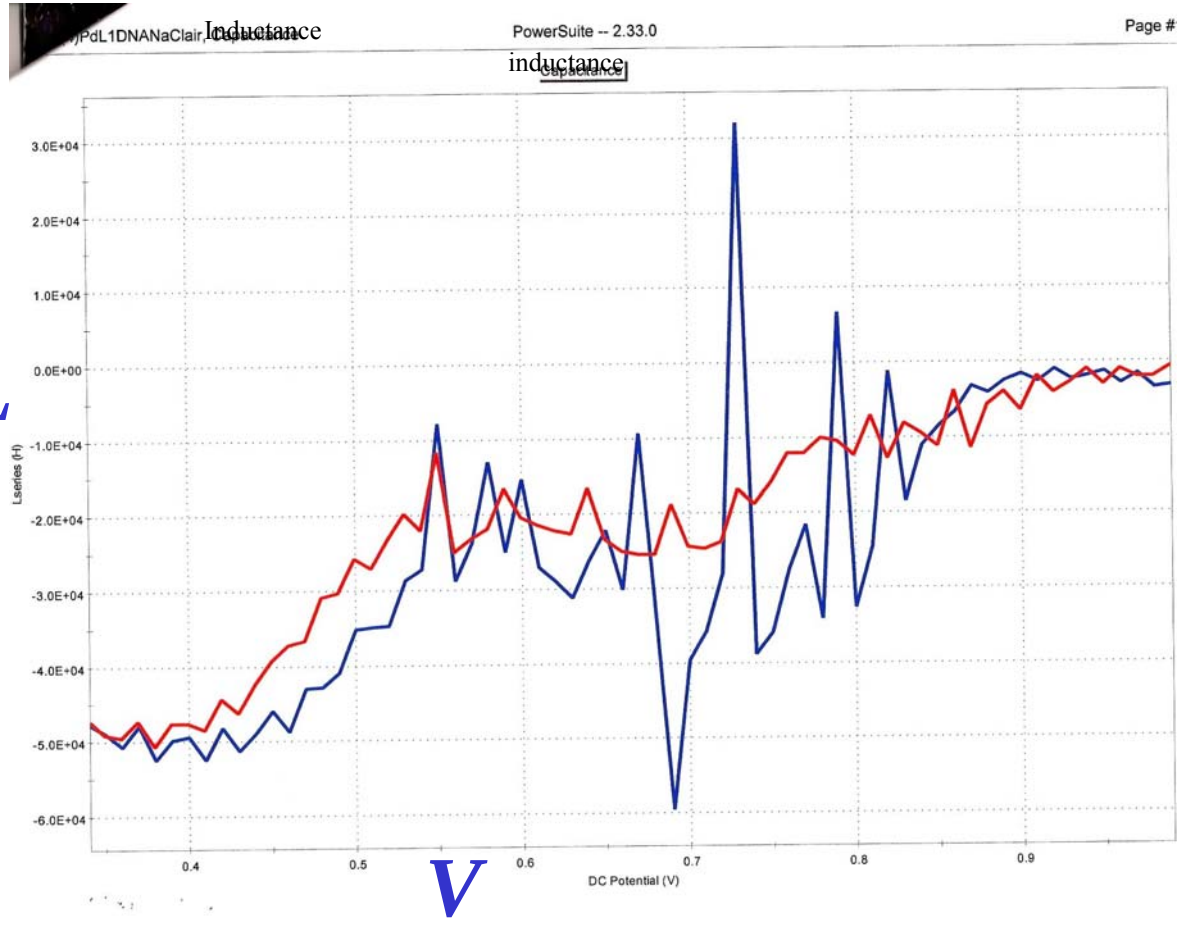


L

V

+

Interaction of Pd-lipoic acid (red), with added DNA (blue) –Single frequency inductance/ Au//NaCl/air → induced oscillation

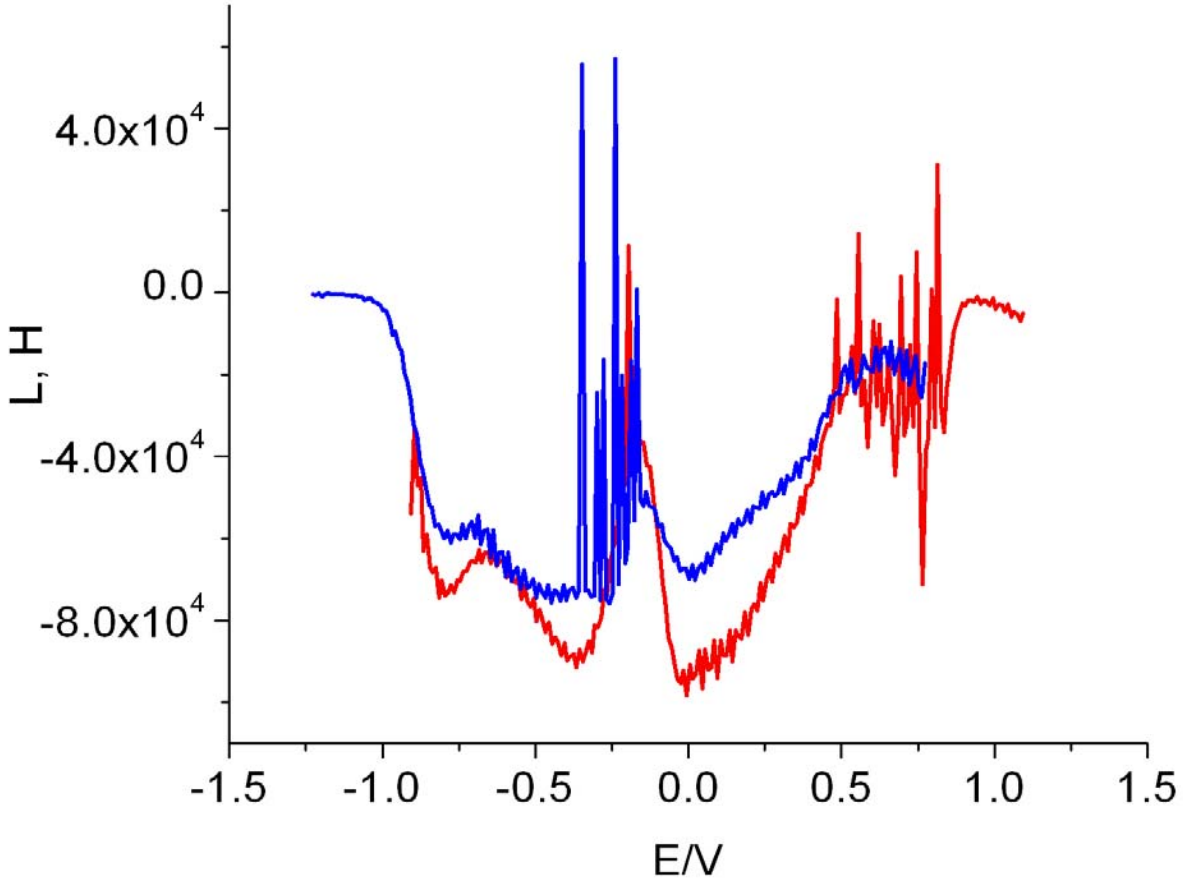


L

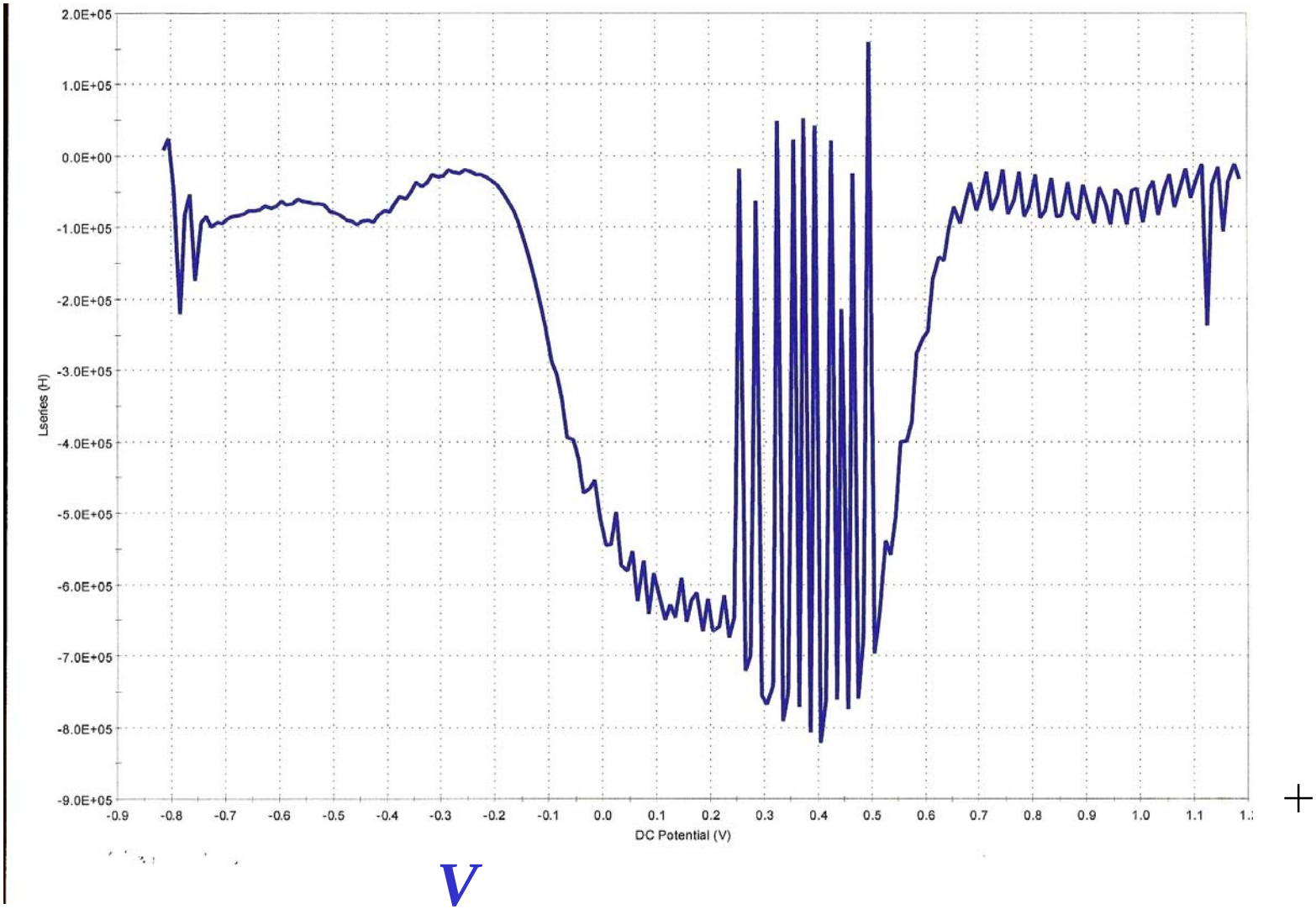
V

+

Inductance scan : Pd-lipoic acid (red), and combined with DNA (blue) / Au electrode/ Na Acetate / N_2



A potent inductance oscillator -



Answers to some of the questions :

1. *The liquid crystal waveforms are a model for a liquid crystal Bloch wave analogous to solid state.*
2. *The inductance oscillation is a rapid electromagnetic signal system.*
3. *The Negative Differential Resistance is from a stabilized spin-charge structure.*
4. *The double layer acquires additional stability from the bridging paramagnetic species (spin-polarization).*

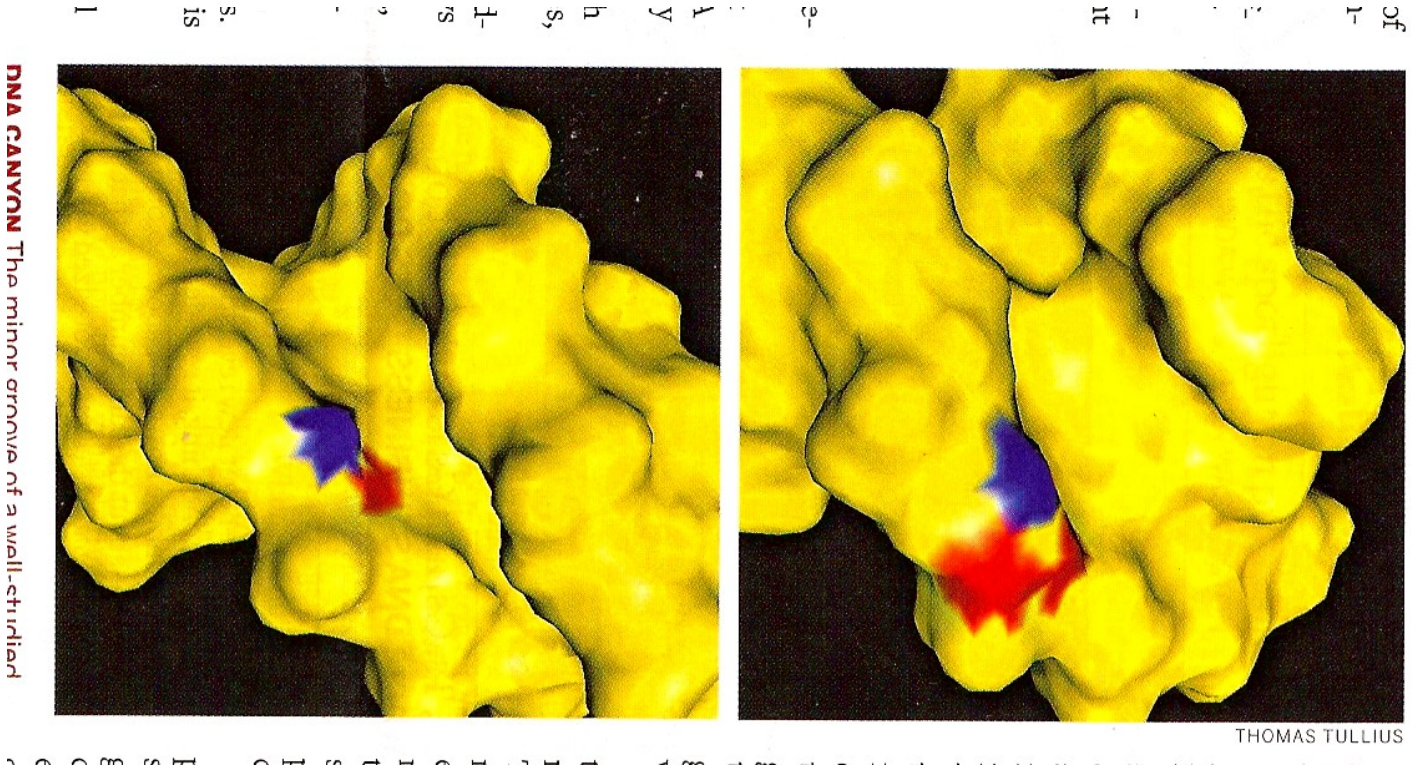
Electronic oscillation of DNA requires a free radical source - either oxygen or palladium or an organic radical. This paramagnetic influence propagates through the piezoelectric structure of the DNA liquid crystal double layer, which then behaves as a thin film for wave propagation.

questions :

1. *Can we measure variations in electronic configurations in DNA ?*
2. *Can we measure electronic deformities in DNA ?*
3. *Can we measure the relation of the electronics of DNA to cancer ?*
4. *Can we alter gene structure with paramagnetic agents ?*

Chem.Eng.News 5-18-09 : DNA's First Language

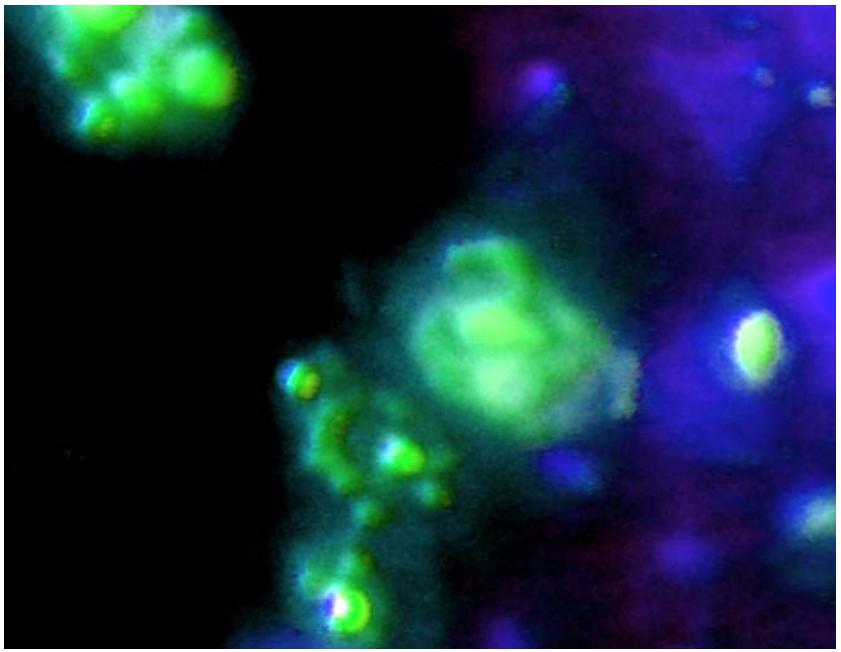
"the width of the minor groove shapes the electrical potential and this is used to discriminate among similar proteins to orchestrate development."

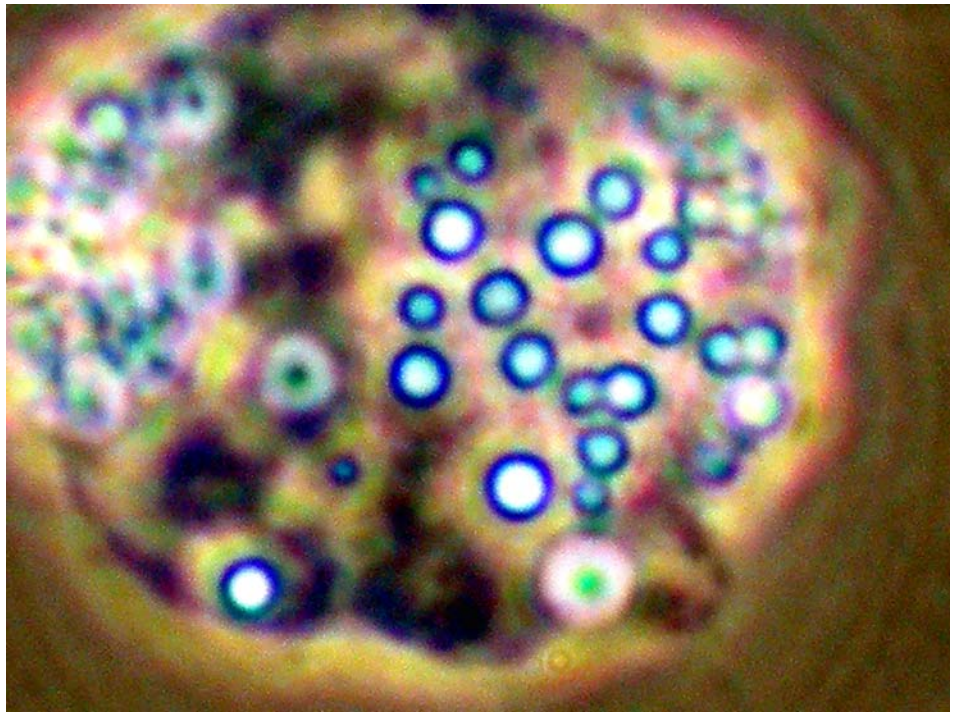


DNA CANYON The minor groove of a well-studied

THOMAS TULLIUS

Manipulation of DNA charge and frequency of oscillation to produce ring chromosomes





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