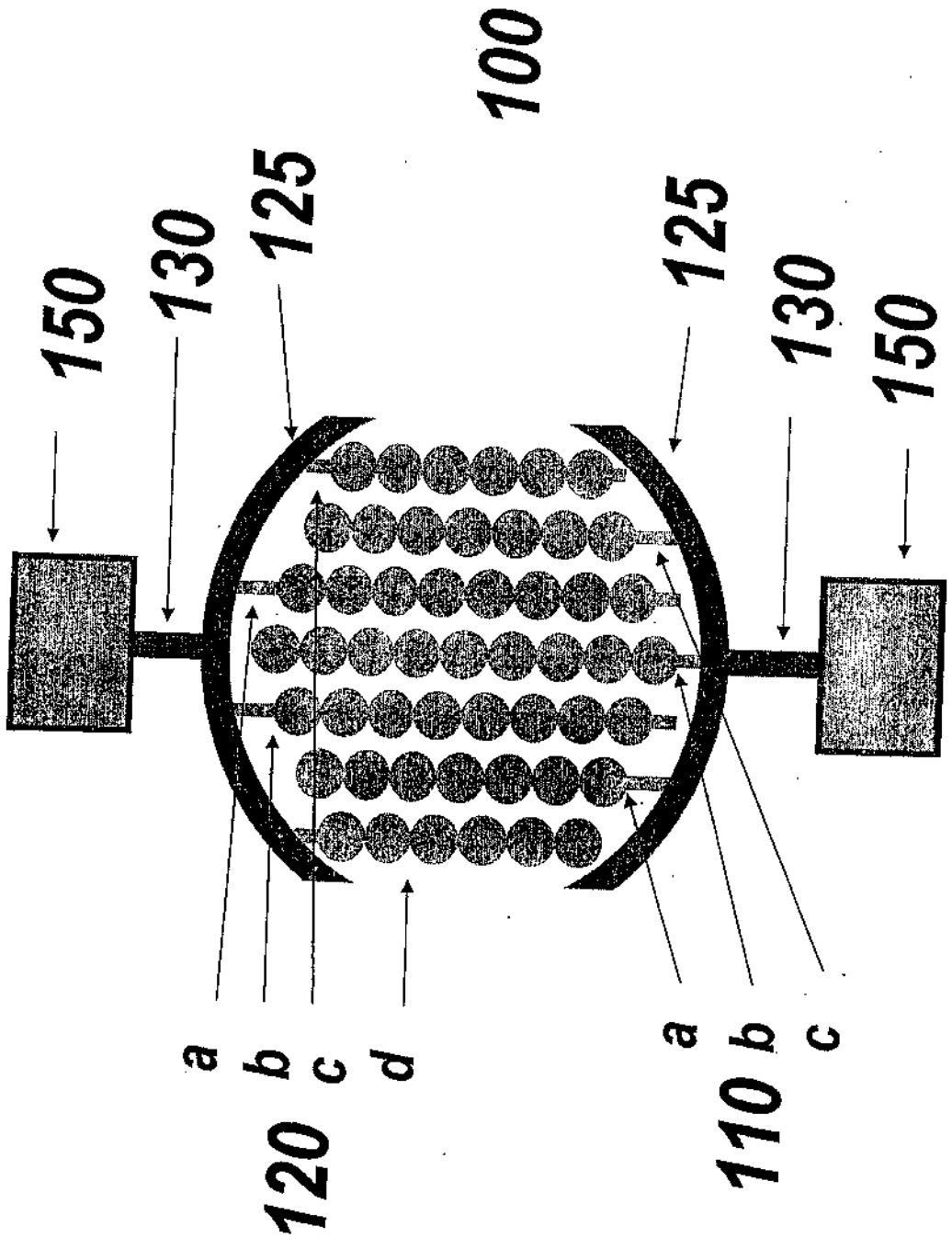


Figure 1A

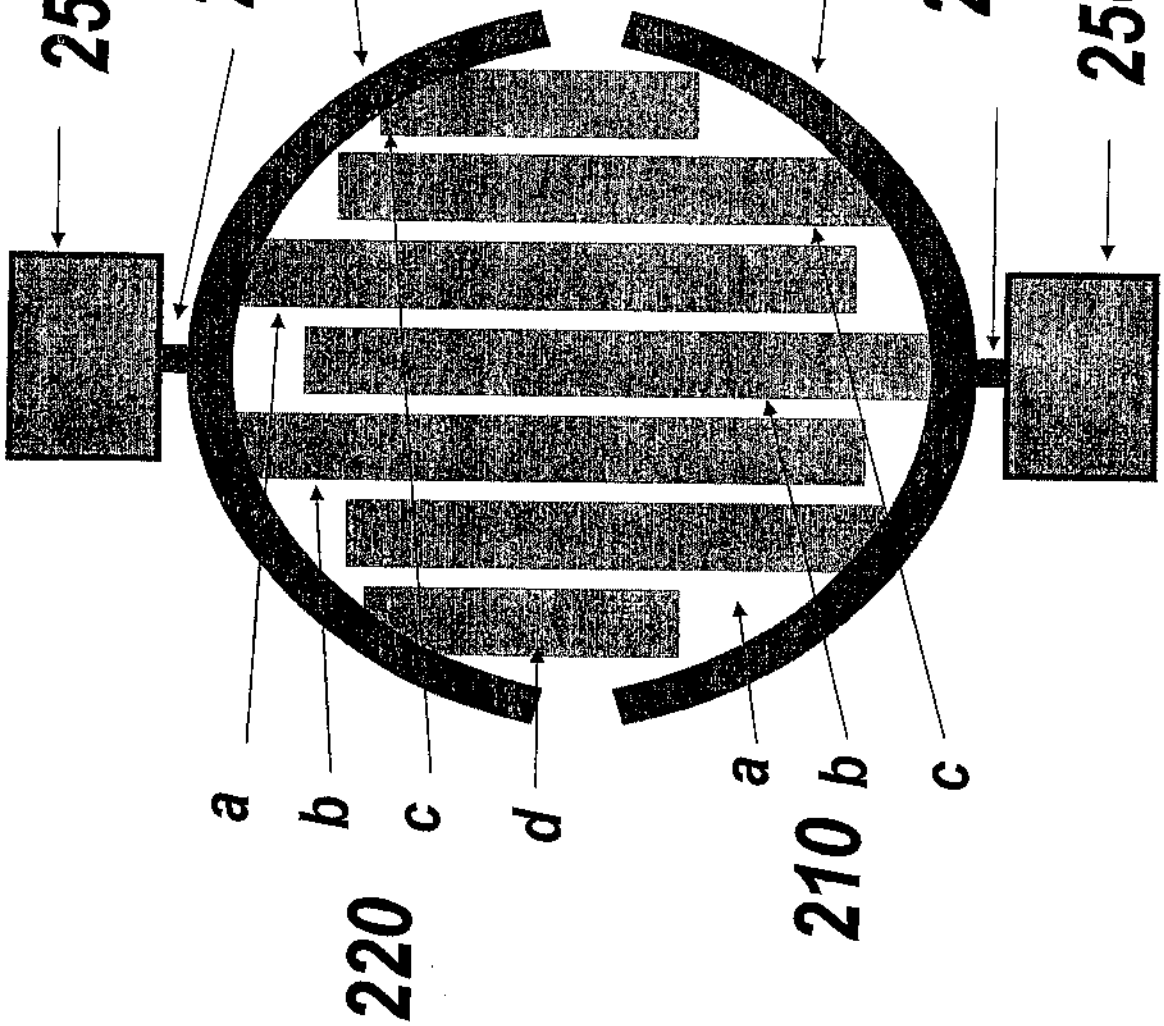


Figure 1B

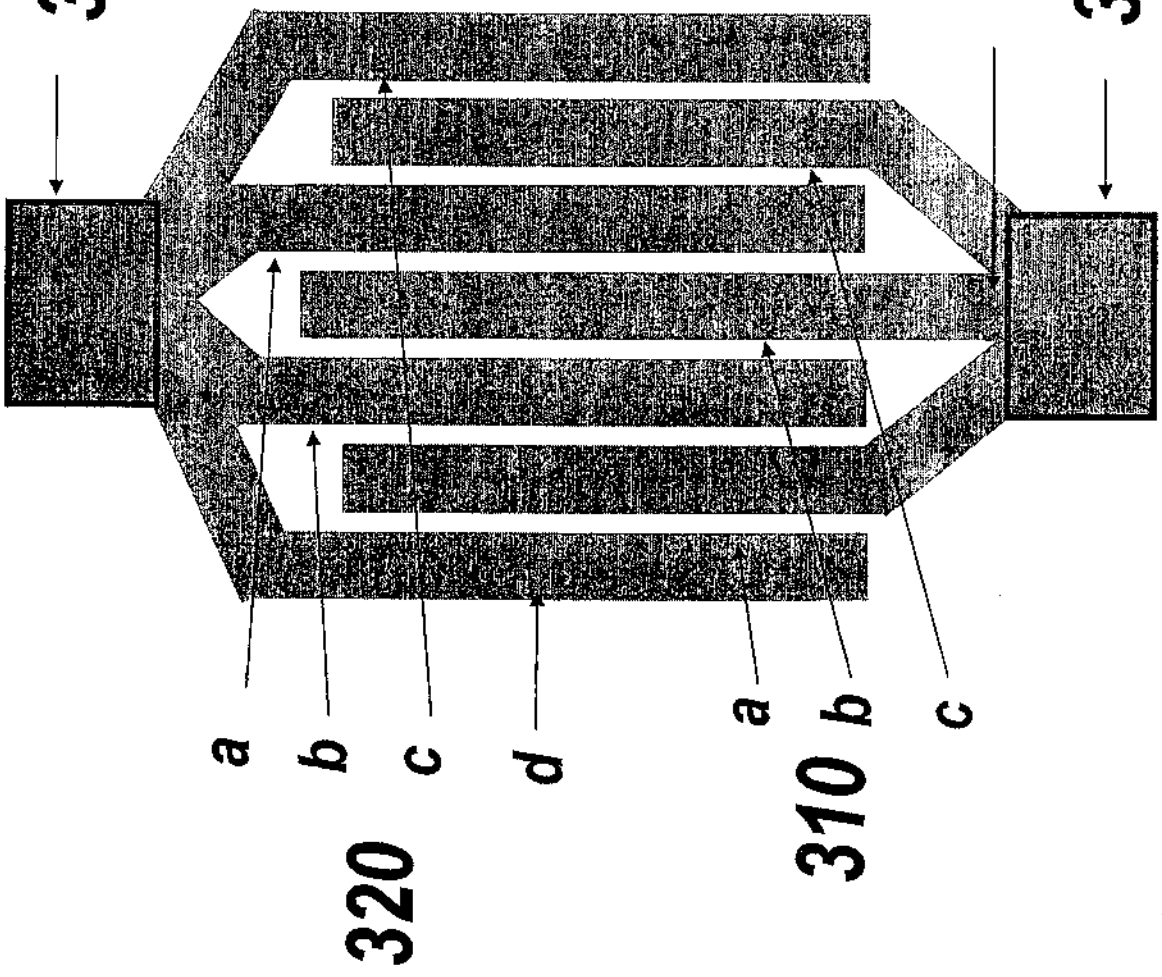


Figure 1C

Figure 2

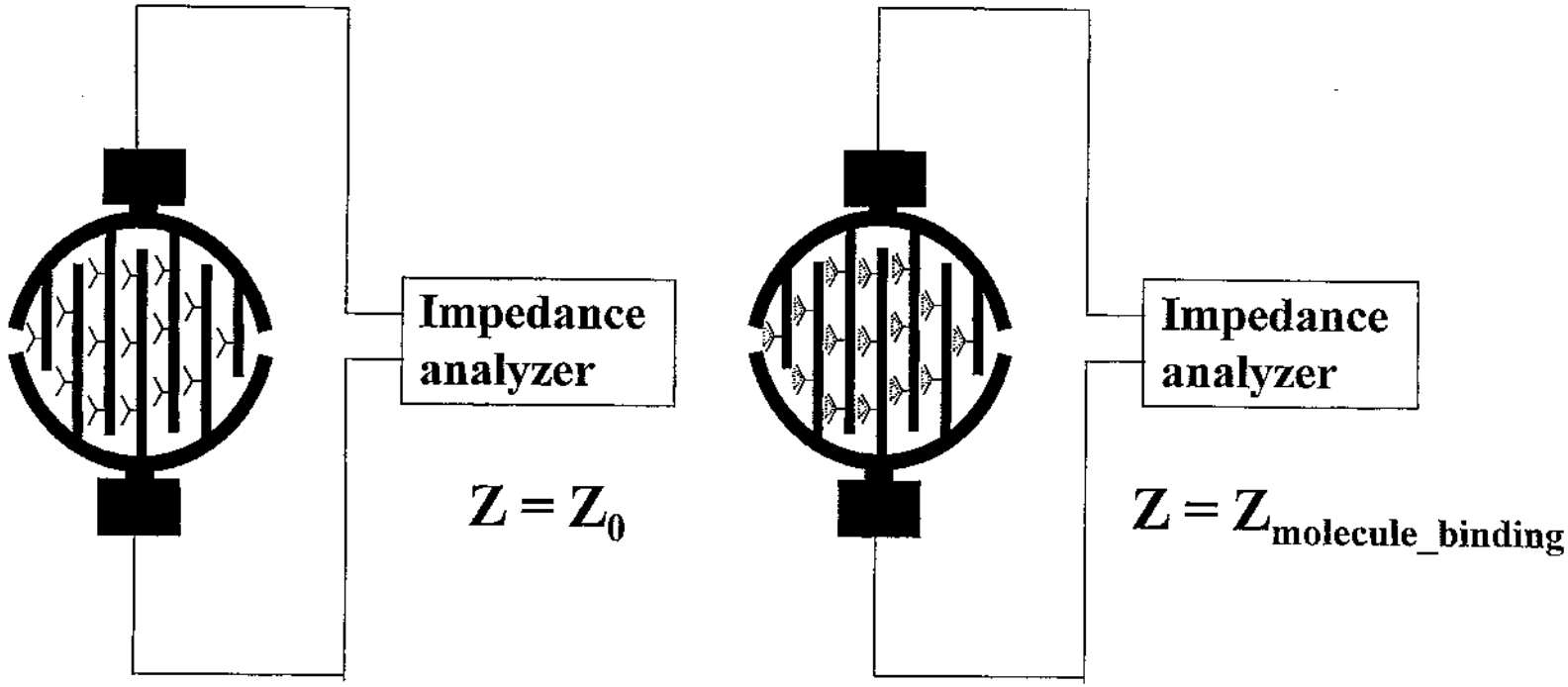
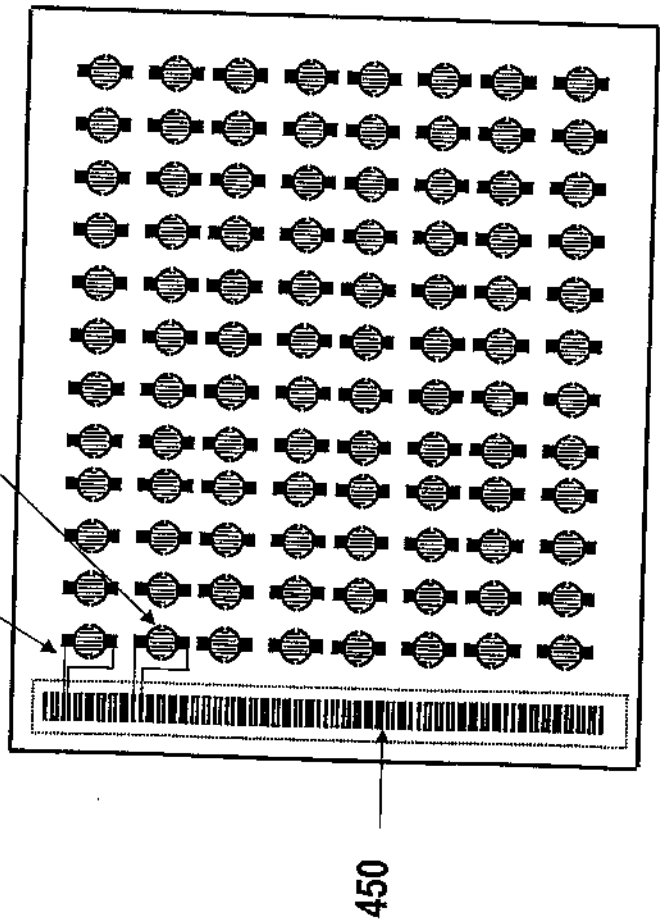

Impedance analyzer
$Z = Z_0$
Impedance analyzer
$Z = Z_{molecule_binding}$

Figure 3



Microelectrode plate (96-well plate)

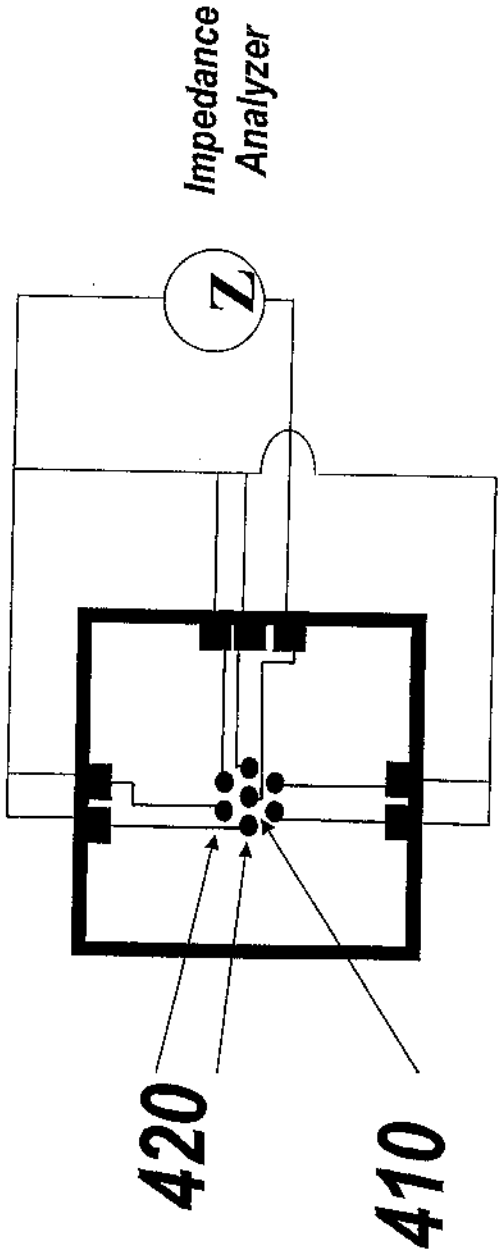


Figure 4A

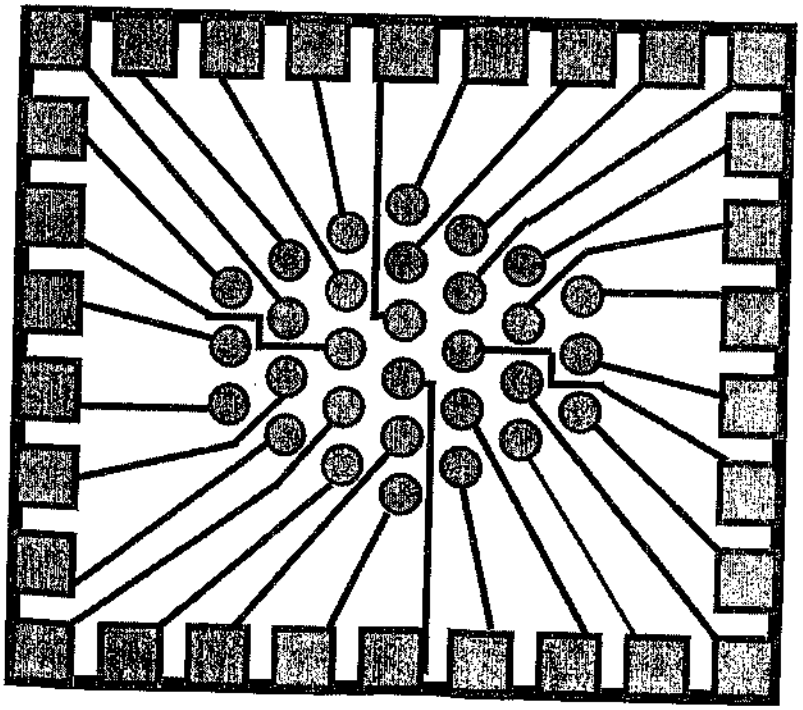


Figure 4B

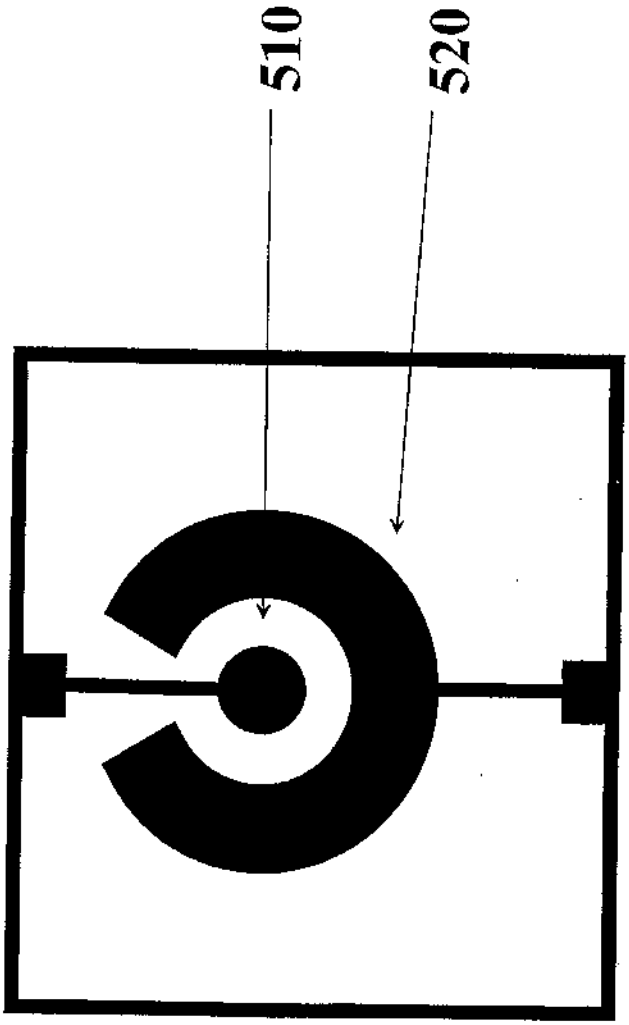


Figure 5

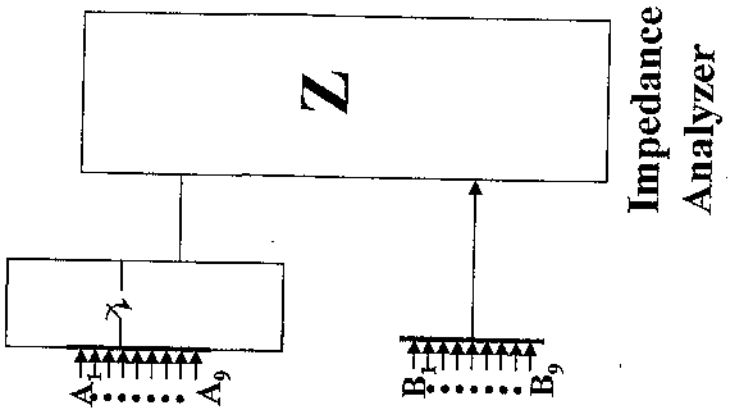
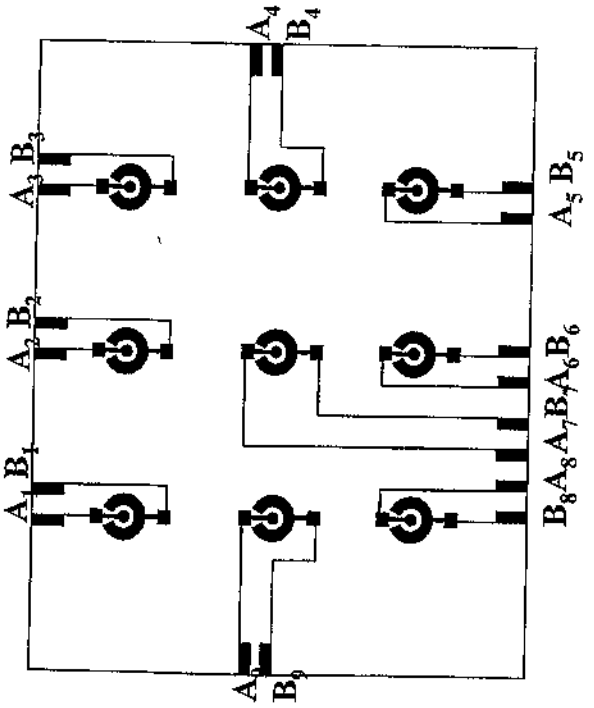

Z
Impedance Analyzer
A1 ..... A9
B1 ..... B9

Figure 6


A1 B1
A2 B2
A3 B3
A4 B4
A5 B5
B8 A8 A7 B7 A6 B6
A9 B9

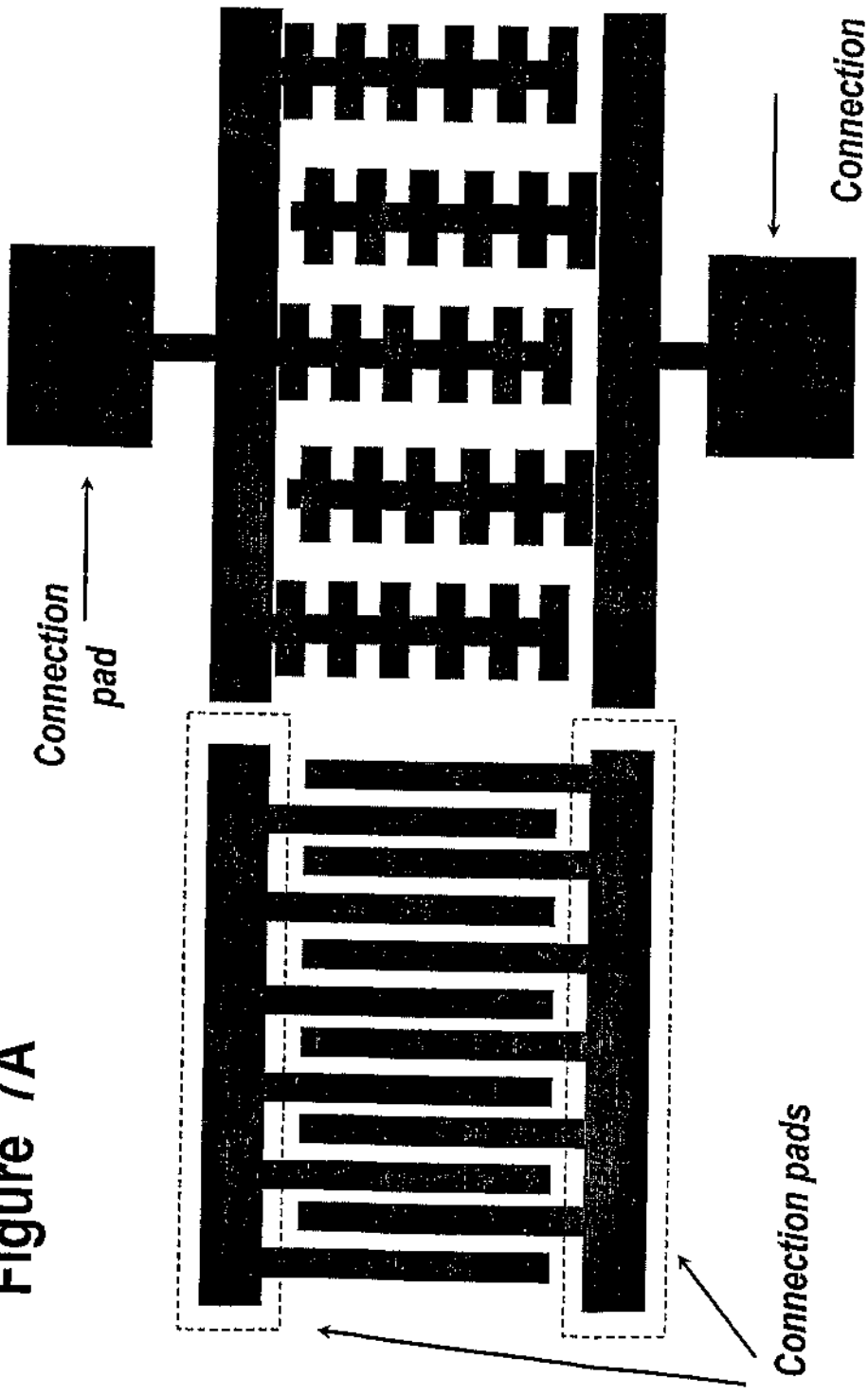


Figure 7A

Figure 7B

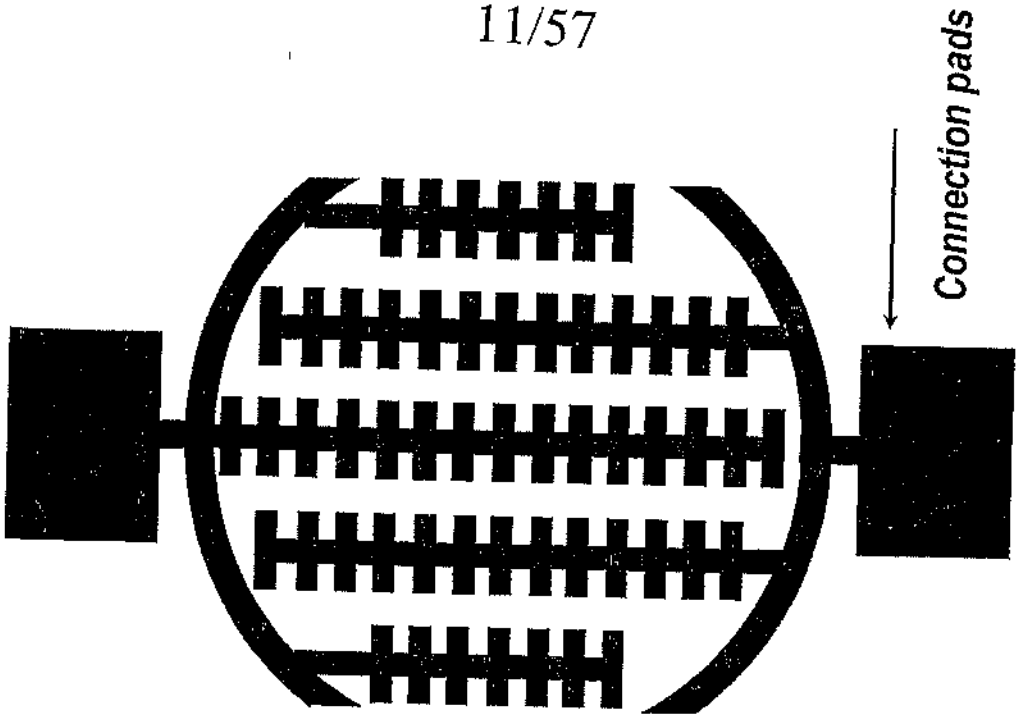


Figure 7D

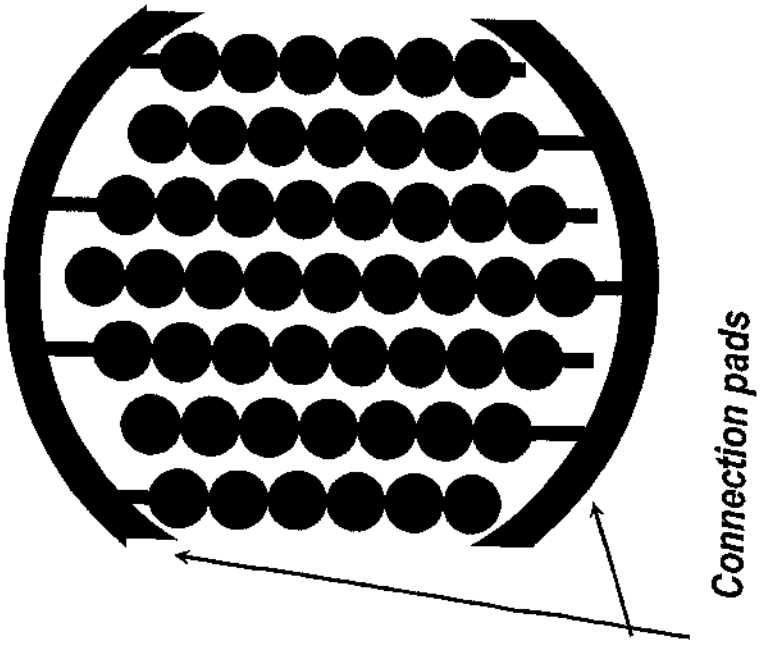
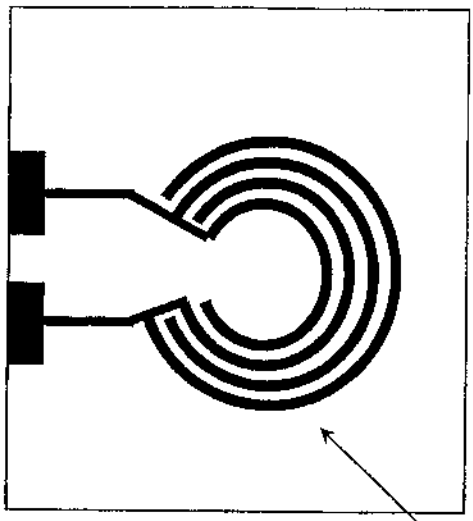
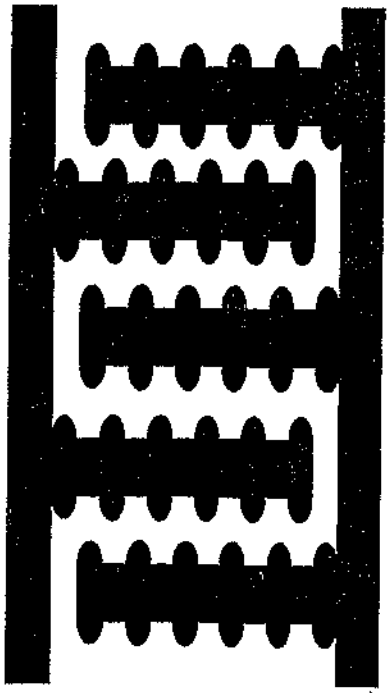


Figure 7C



Concentric electrode structures

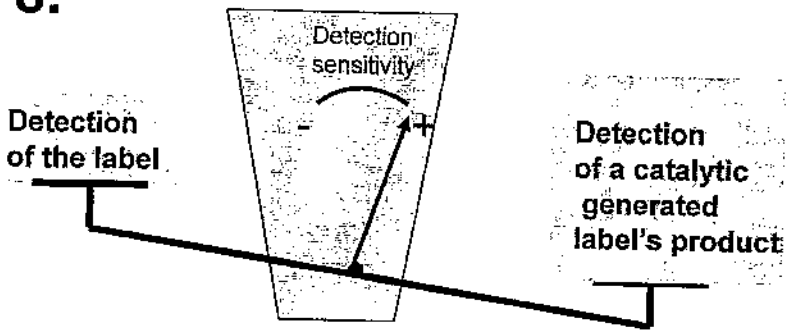
Figure 7F



Connection pads

Figure 7E

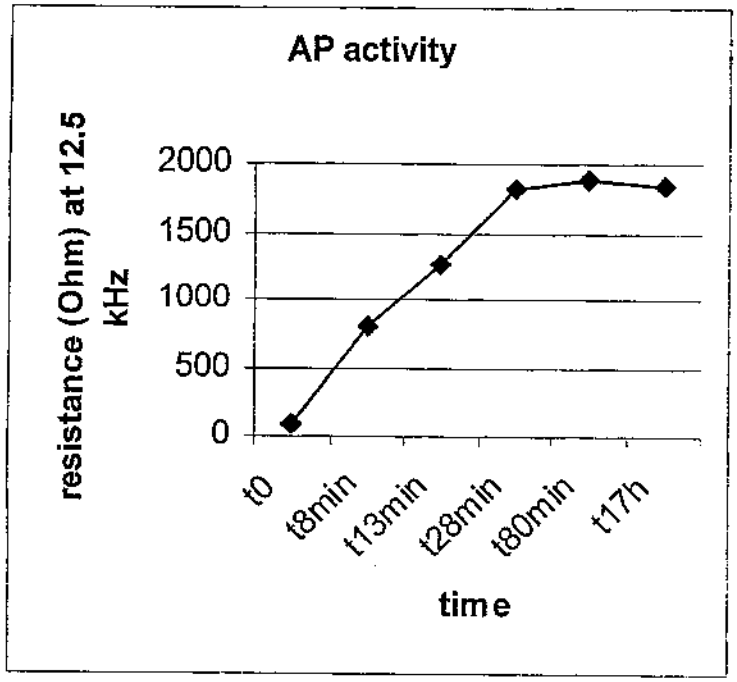
Figure 8.



Signal amplification for improved detection sensitivity by indirect measuring catalytic products of enzyme-mediated reactions. Examples of enzymes commonly used include alkaline phosphatase (AP) and horseradish peroxidase (HRP). Here are some typical reactions used.

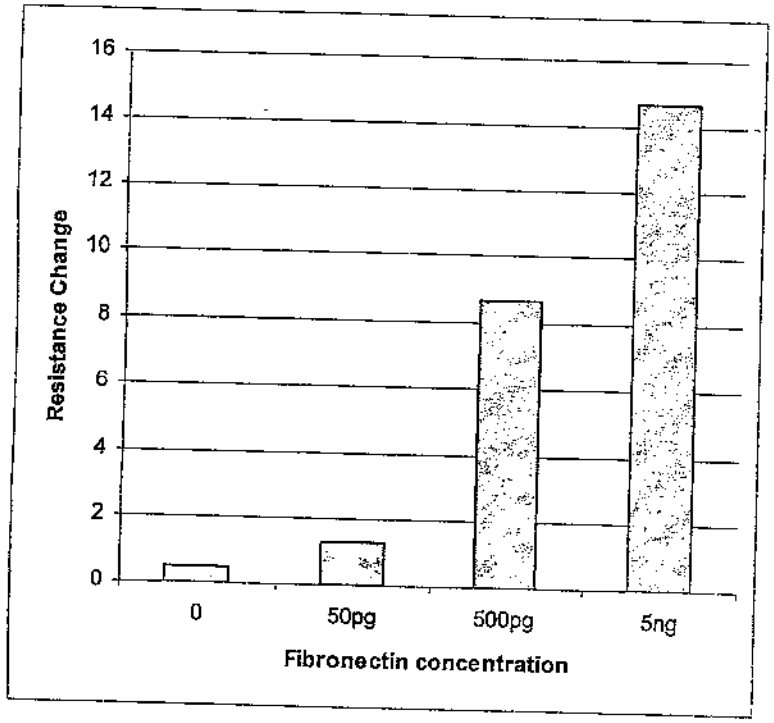
Enzyme	Reagents	Reaction
HRP	4-chloro-1-napthol (4CN)	Oxidized products form purple precipitate
HRP	3,3'-diaminobenzidine (DAB, with or without $NiCl_2$)	Forms dark brown precipitate
HRP	3,3',5,5'-tetramethylbenzidine (TMB)	Forms dark purple stain
AP	5-bromo-4-chloro-3-indolyl phosphate (BCIP) /nitroblue tetrazolium (NBT)	BCIP hydrolysis products indigo percipitate after oxidation with NBT; reduced NBT precipitates, dark blue-gray stain results

Figure 9.



	Resistance (ohm)
t0	82
t8min	801
t13min	1263
t28min	1825
t80min	1881
t17h	1841

Figure 10.



Fibronectin	Resistance Fold Change
0	0.49
50pg	1.28
500pg	8.66
5ng	14.67

Figure 11.

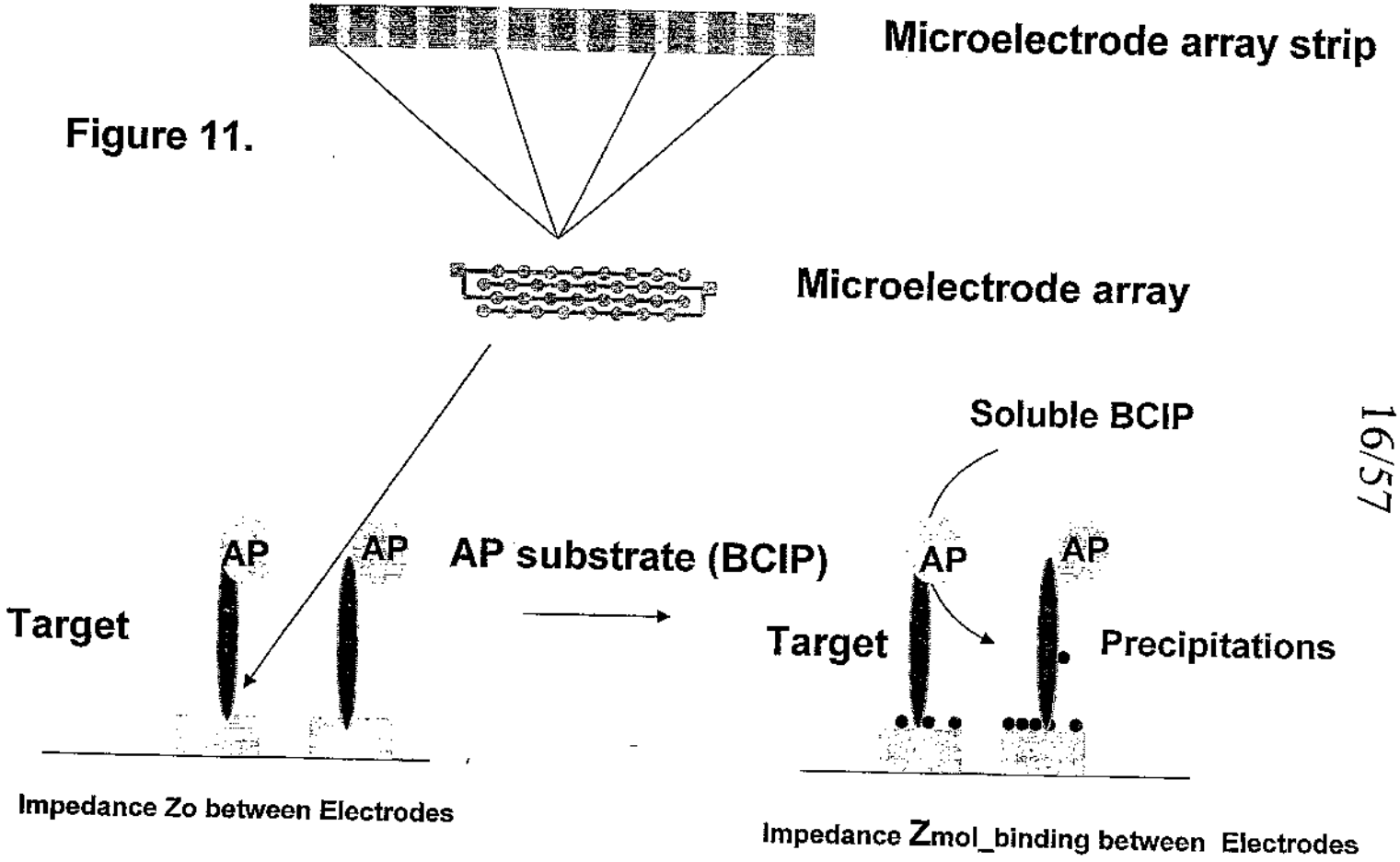

Microelectrode array strip
Microelectrode array
Soluble BCIP
AP
AP
AP substrate (BCIP)
AP
AP
Target
Target
Precipitations
Impedance Zo between Electrodes
Impedance Zmol_binding between Electrodes

Figure 12 A

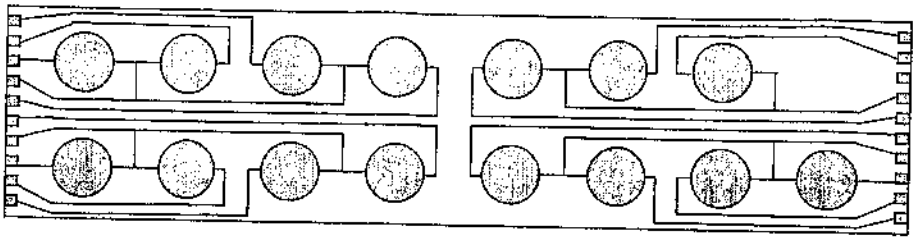


Figure 12 B

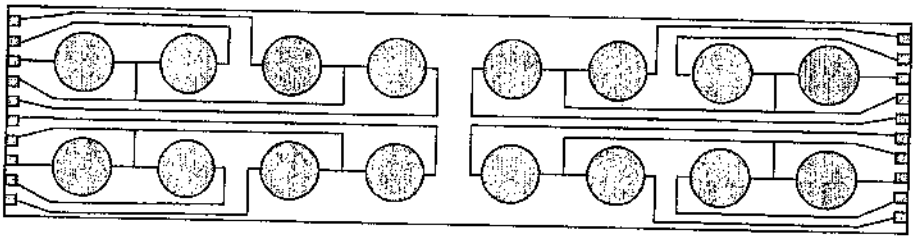


Figure 12 C

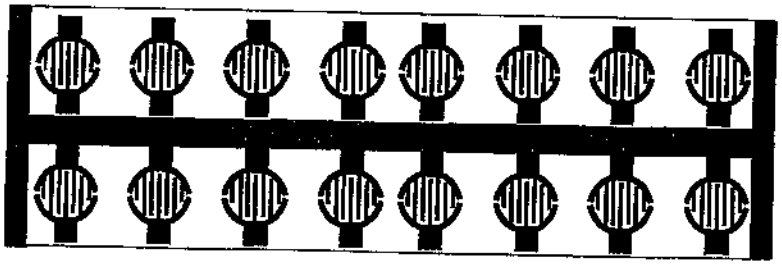
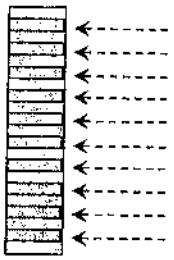


Figure 13 A



Electronic conductor lines

Figure 13 B

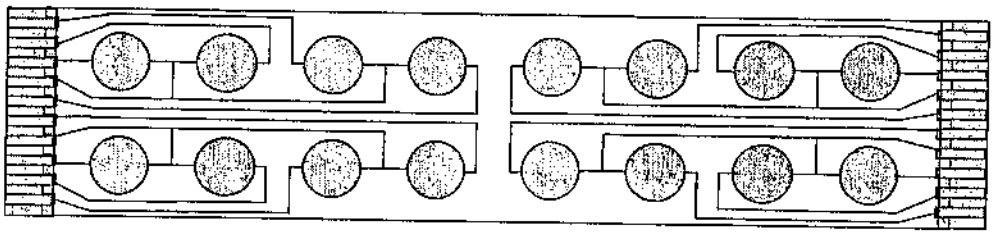


Figure 13 C

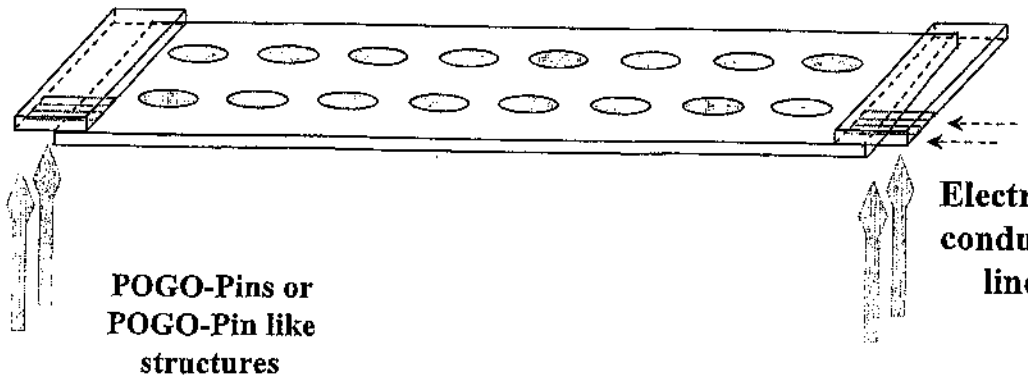


Figure 14 A



Figure 14 B

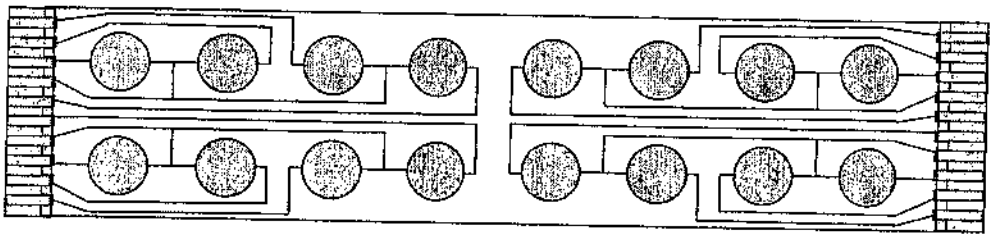


Figure 14 C

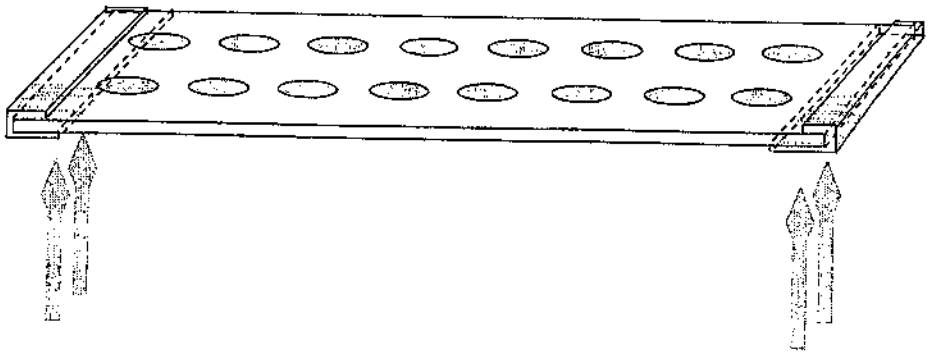


Figure 14 D

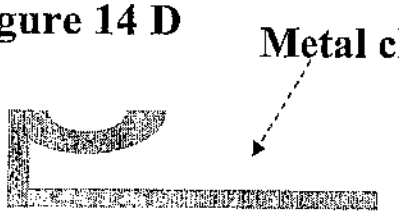


Figure 14 E

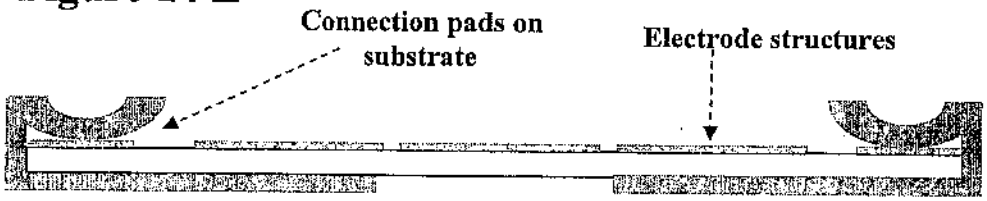


Figure 14 F

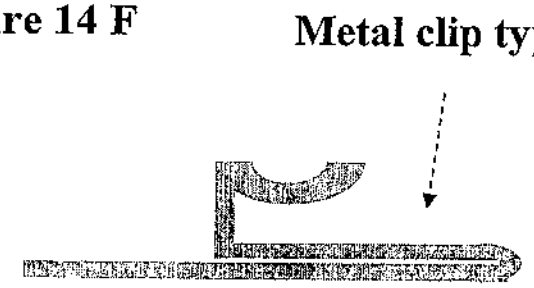


Figure 14 G

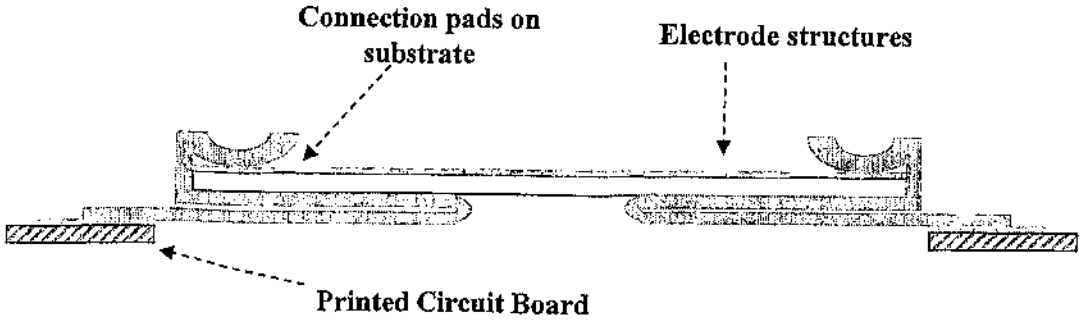


Figure 15(A)

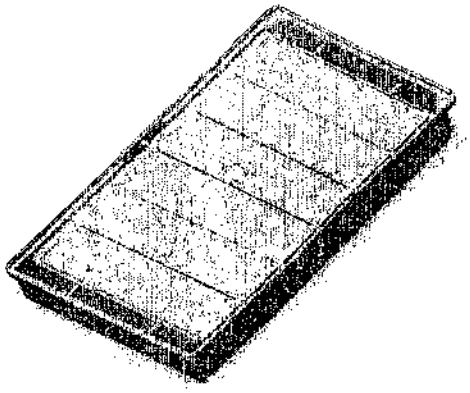


Figure 15(B)

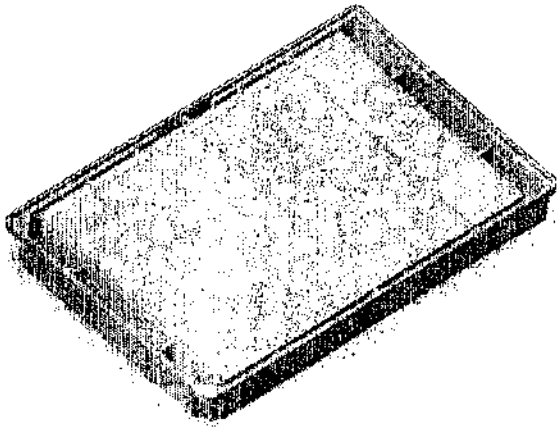
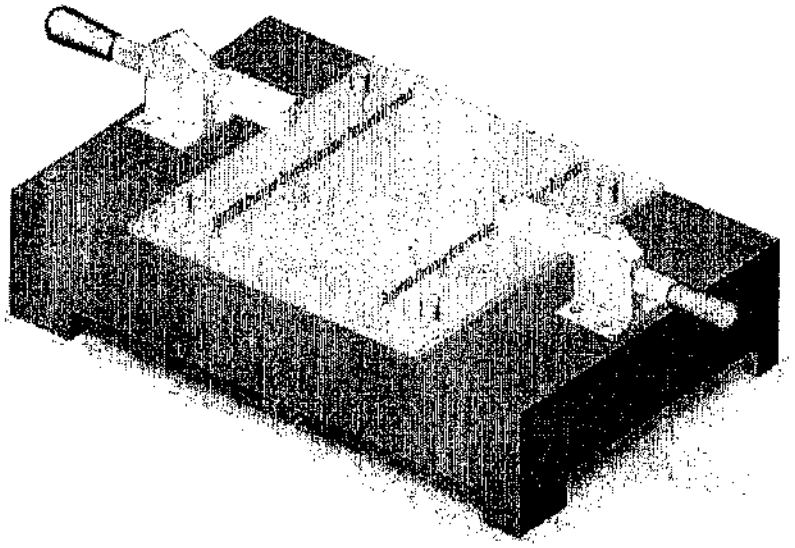


Figure 16.



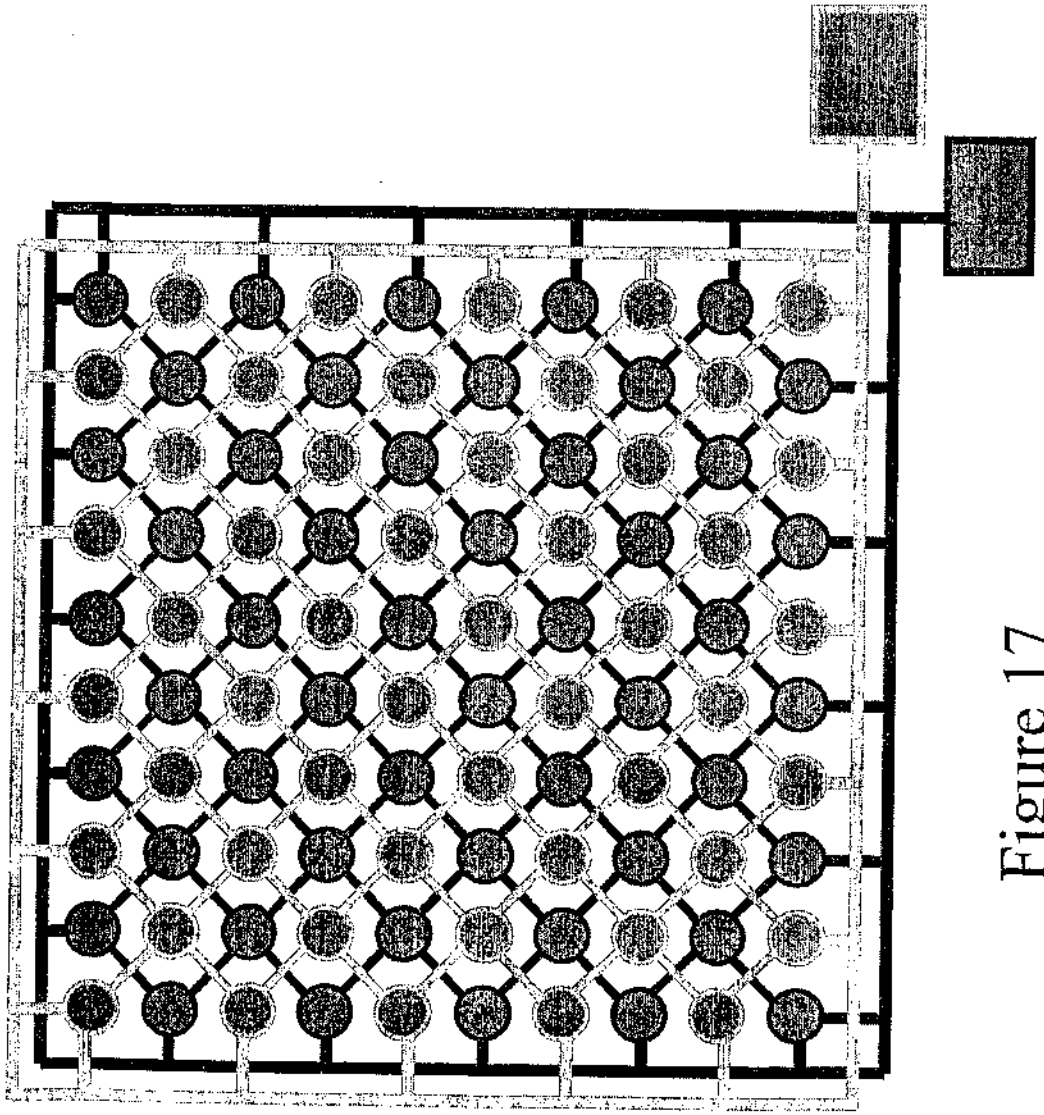


Figure 17

Figure 18

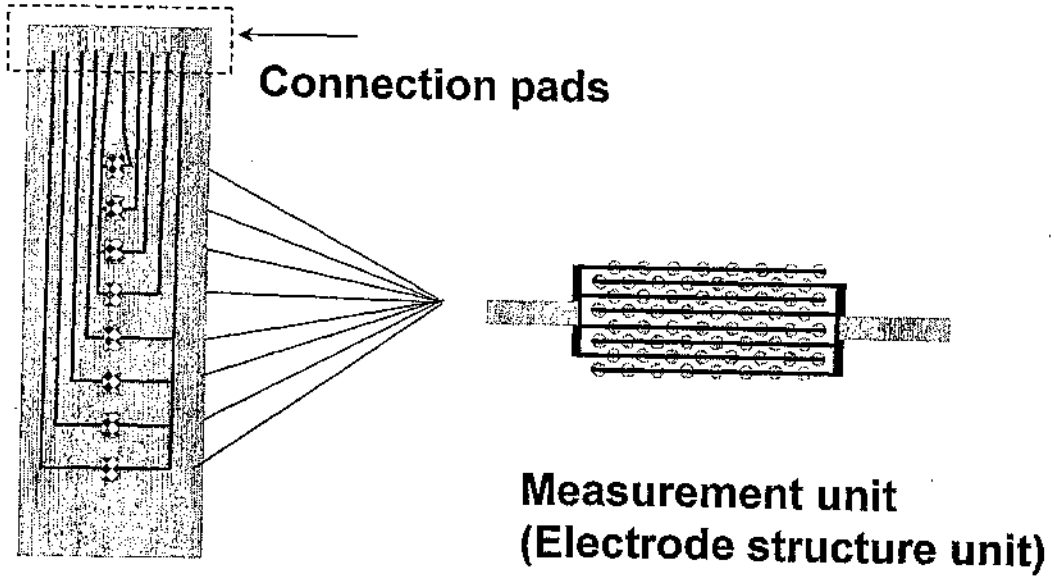

Connection pads
Measurement unit
(Electrode structure unit)
Electrode strip

Figure 19

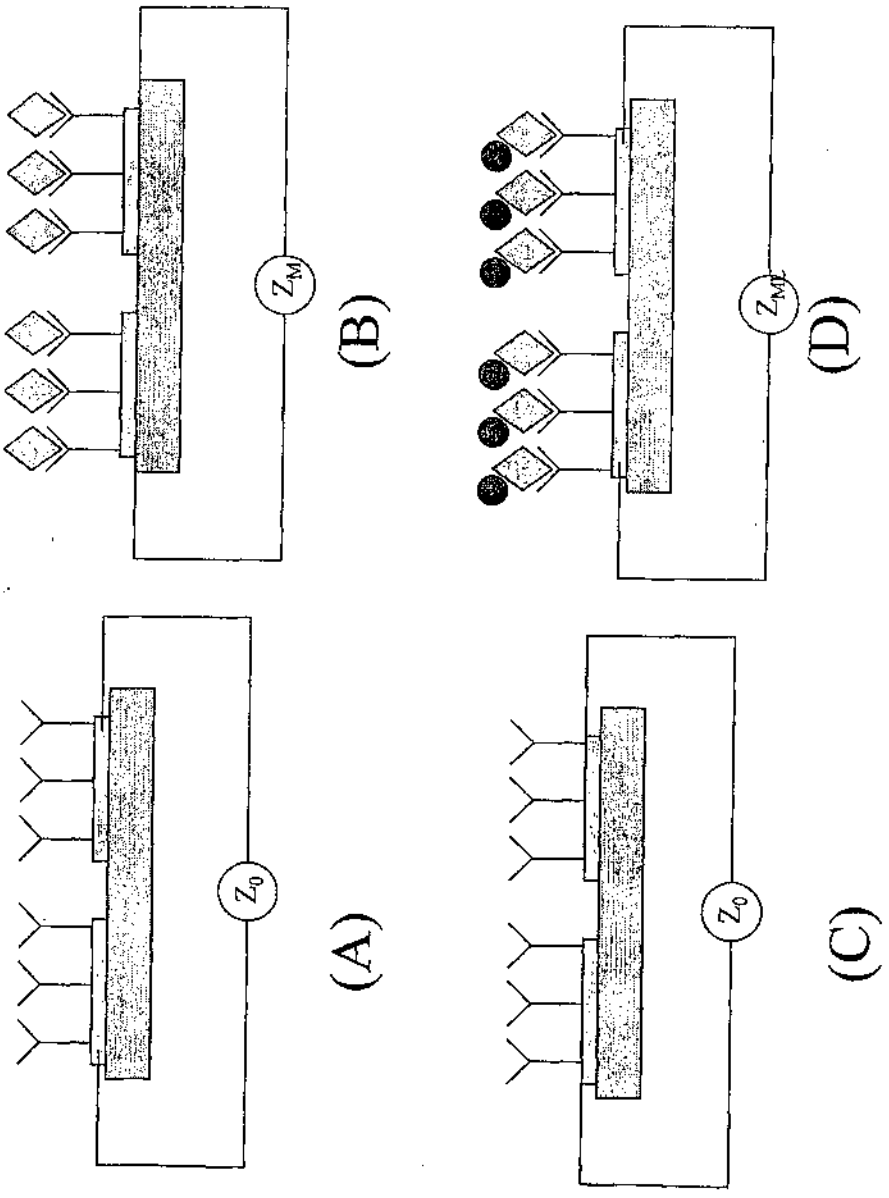
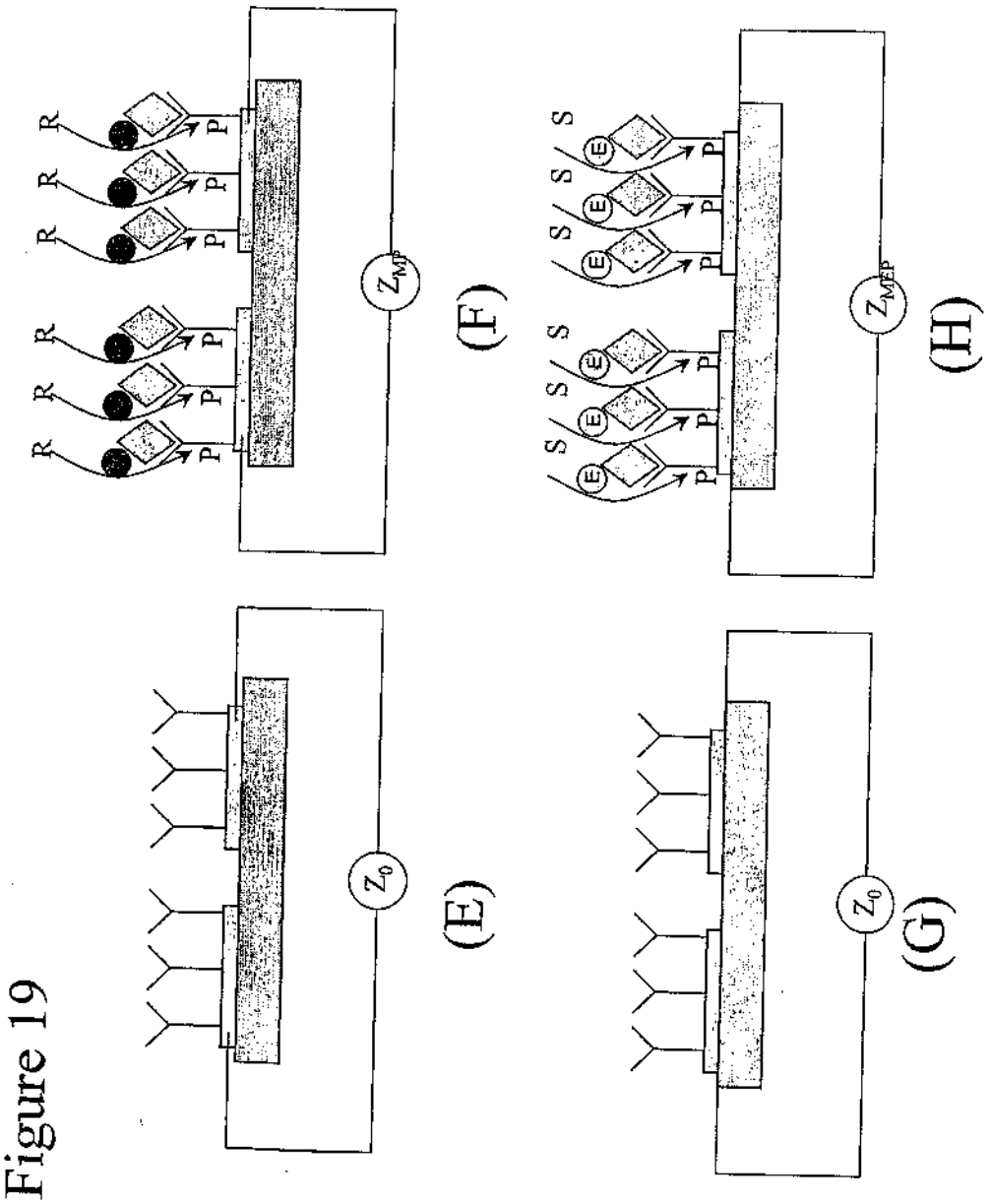


Figure 19



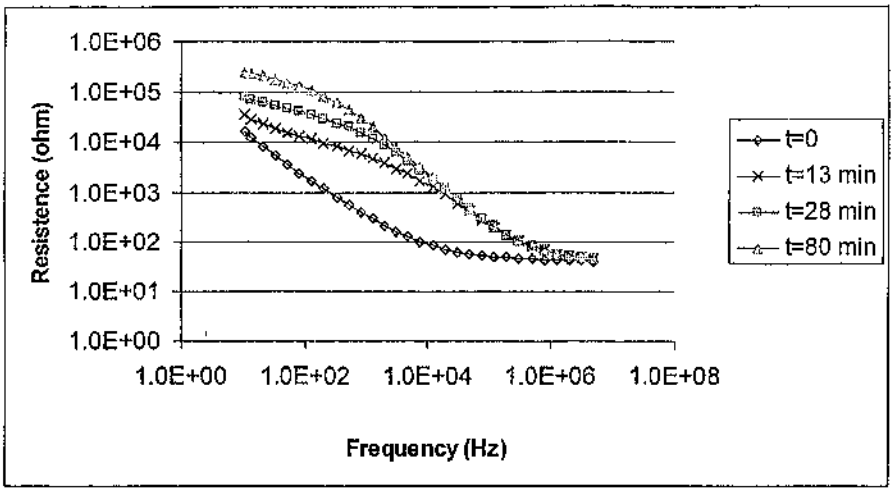


Figure 20 (A)

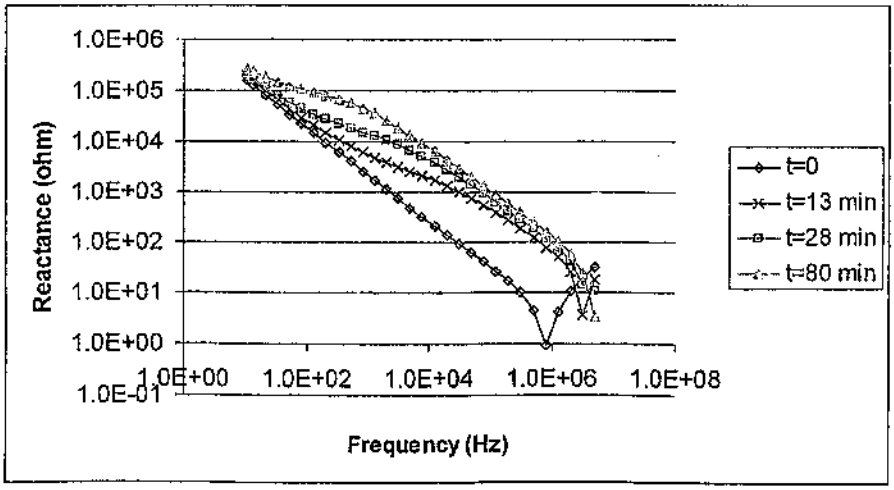


Figure 20 (B)

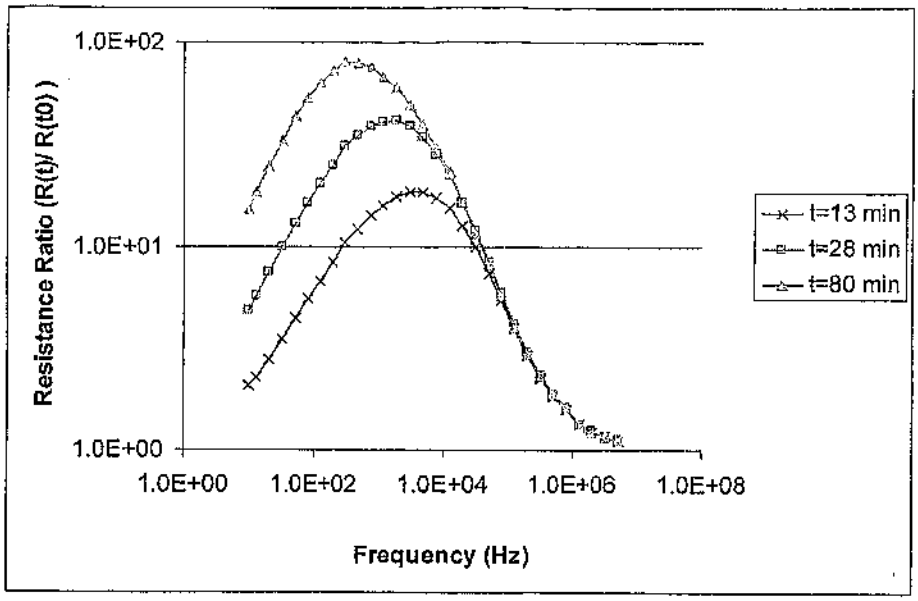


Figure 20(C)

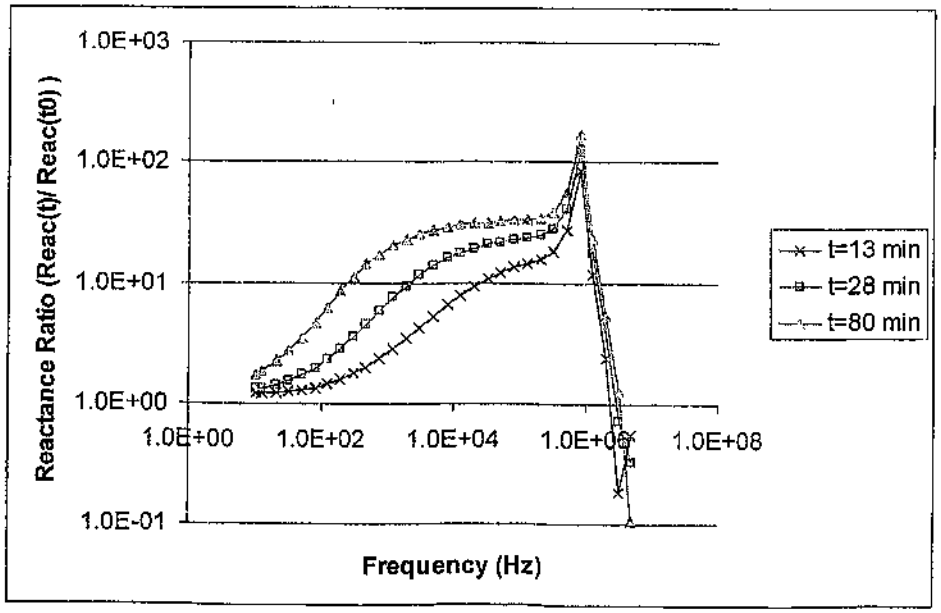


Figure 20(D)

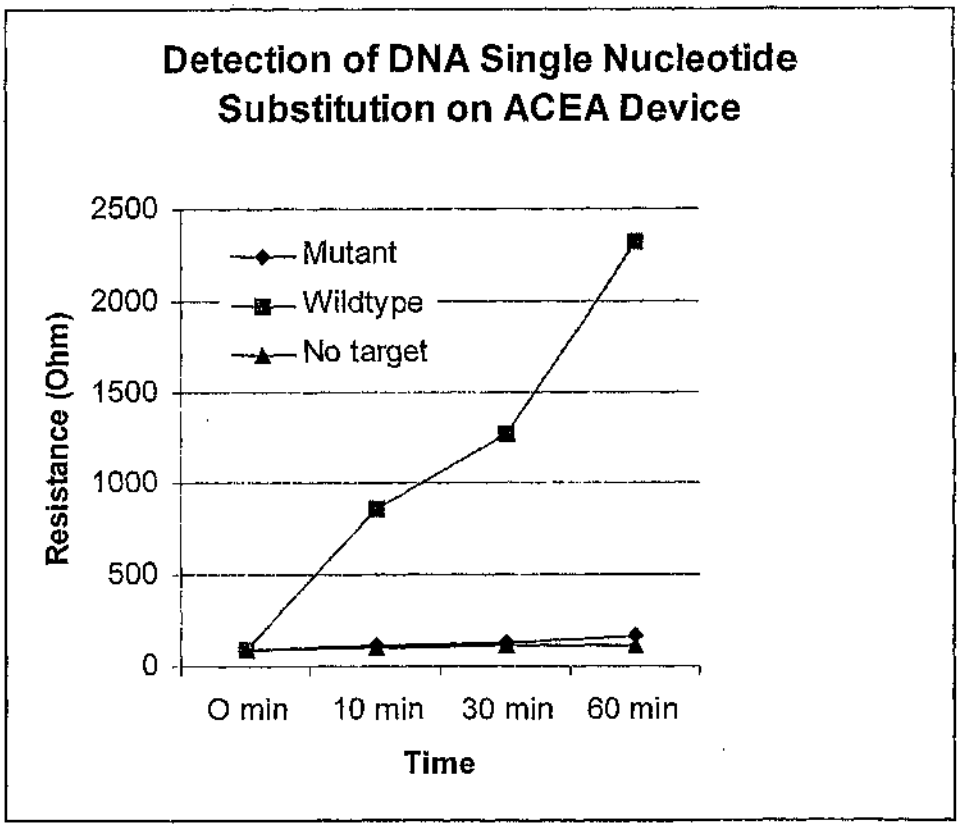

Detection of DNA Single Nucleotide Substitution on ACEA Device
2500
2000
1500
1000
500
0
Resistance (Ohm)
Mutant
Wildtype
No target
O min
10 min
30 min
60 min
Time

Figure 21.

Figure 22

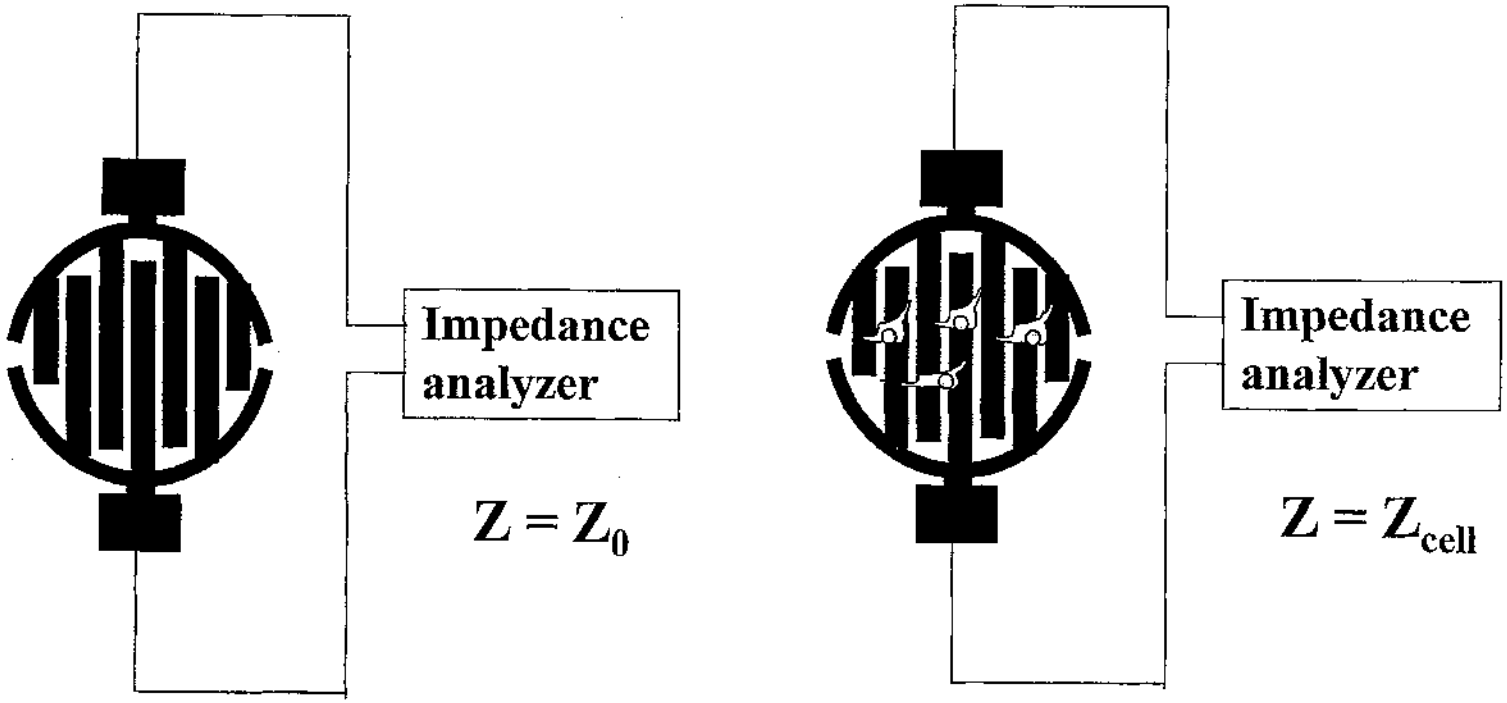


Figure 23

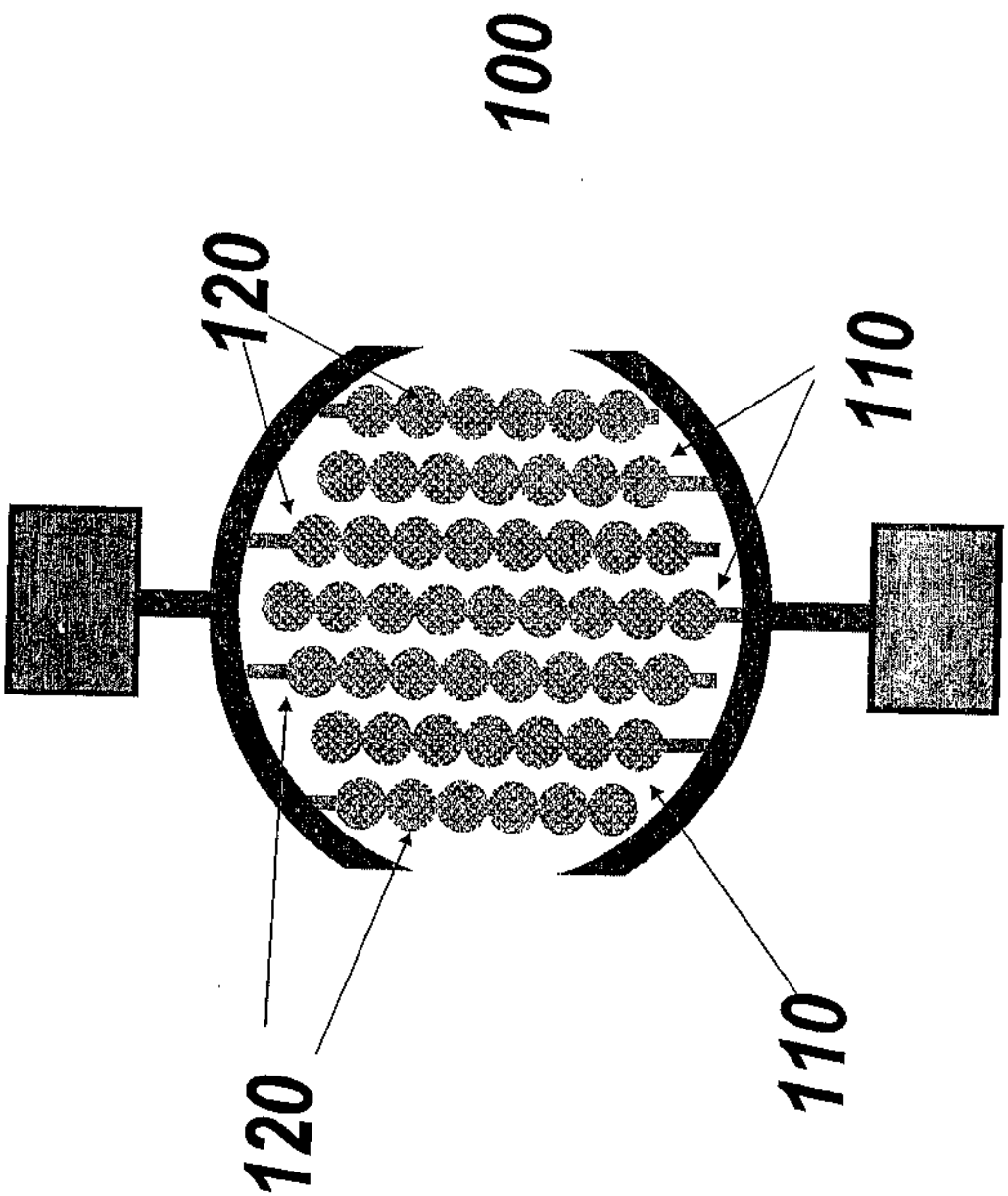


Figure 24

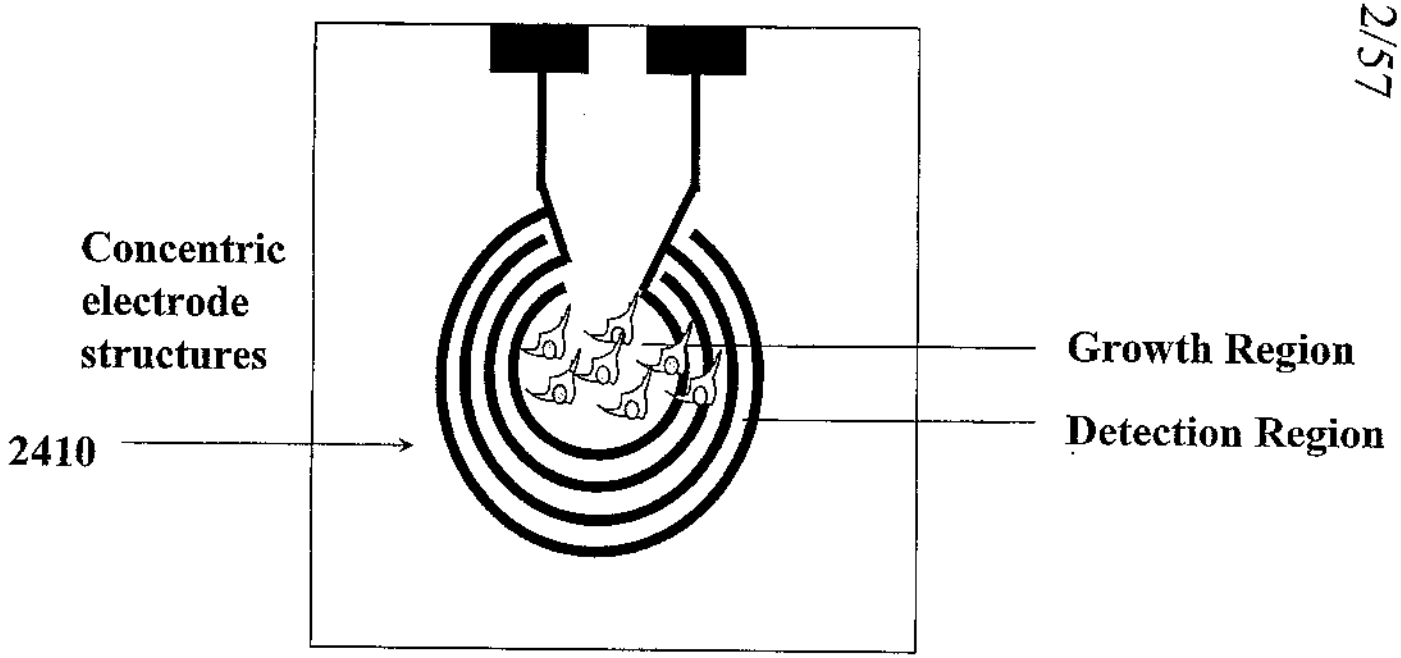

Concentric electrode structures
2410
Growth Region
Detection Region

Figure 25

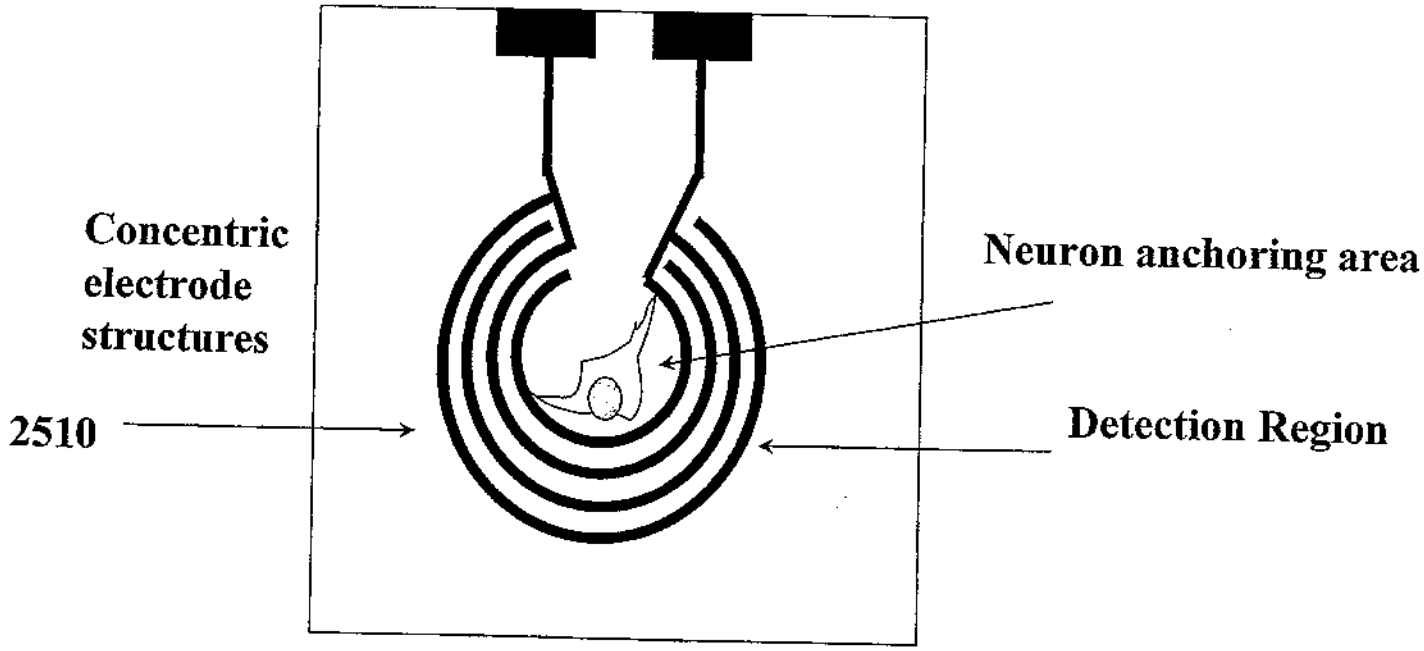

Concentric electrode structures
2510
Neuron anchoring area
Detection Region

Figure 26A (1)

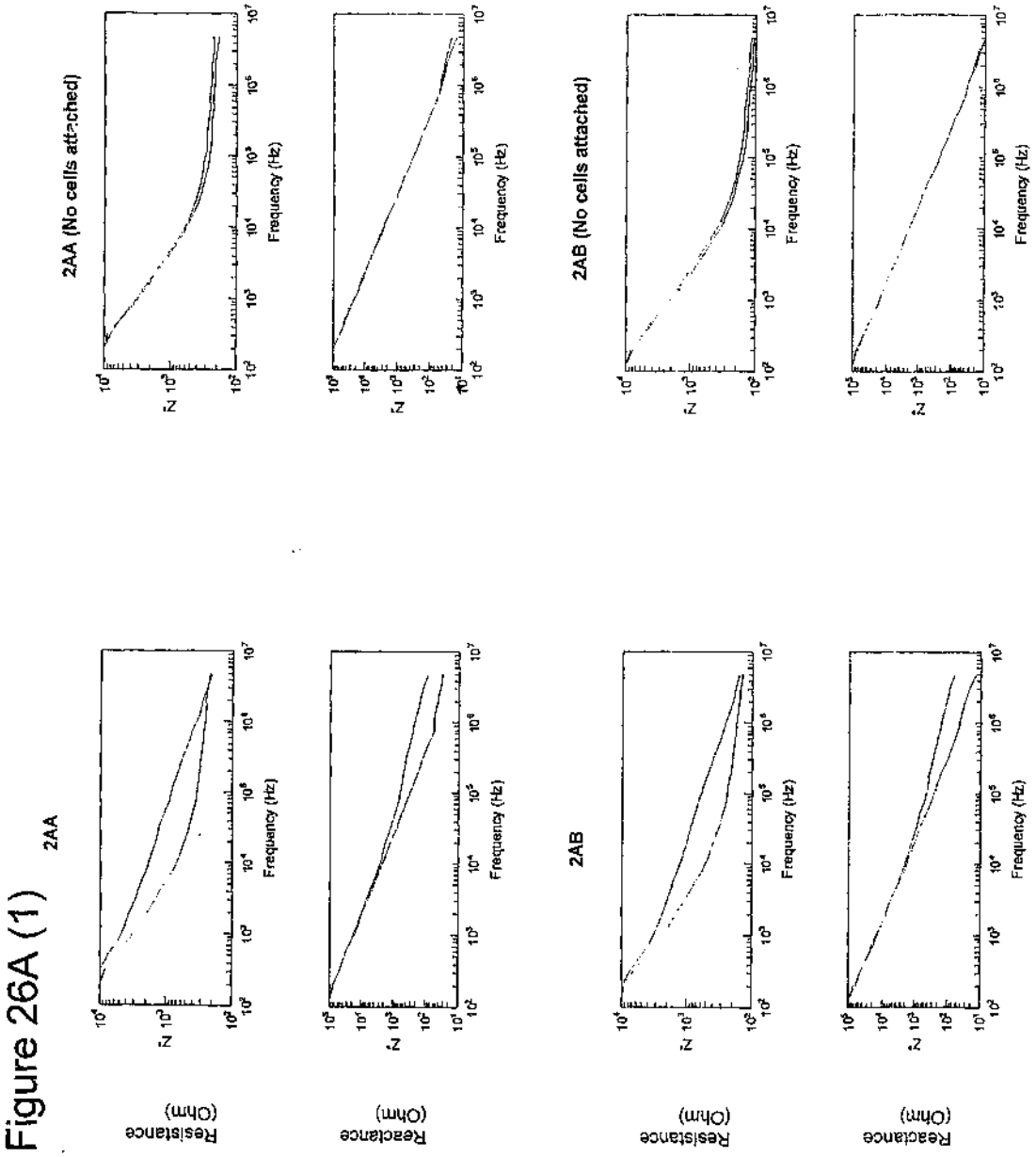

2AA
2AA (No cells attached)
2AB
2AB (No cells attached)
Resistance (Ohm)
Reactance (Ohm)
Frequency (Hz)
|Z|
Z'

Figure 26A (2)

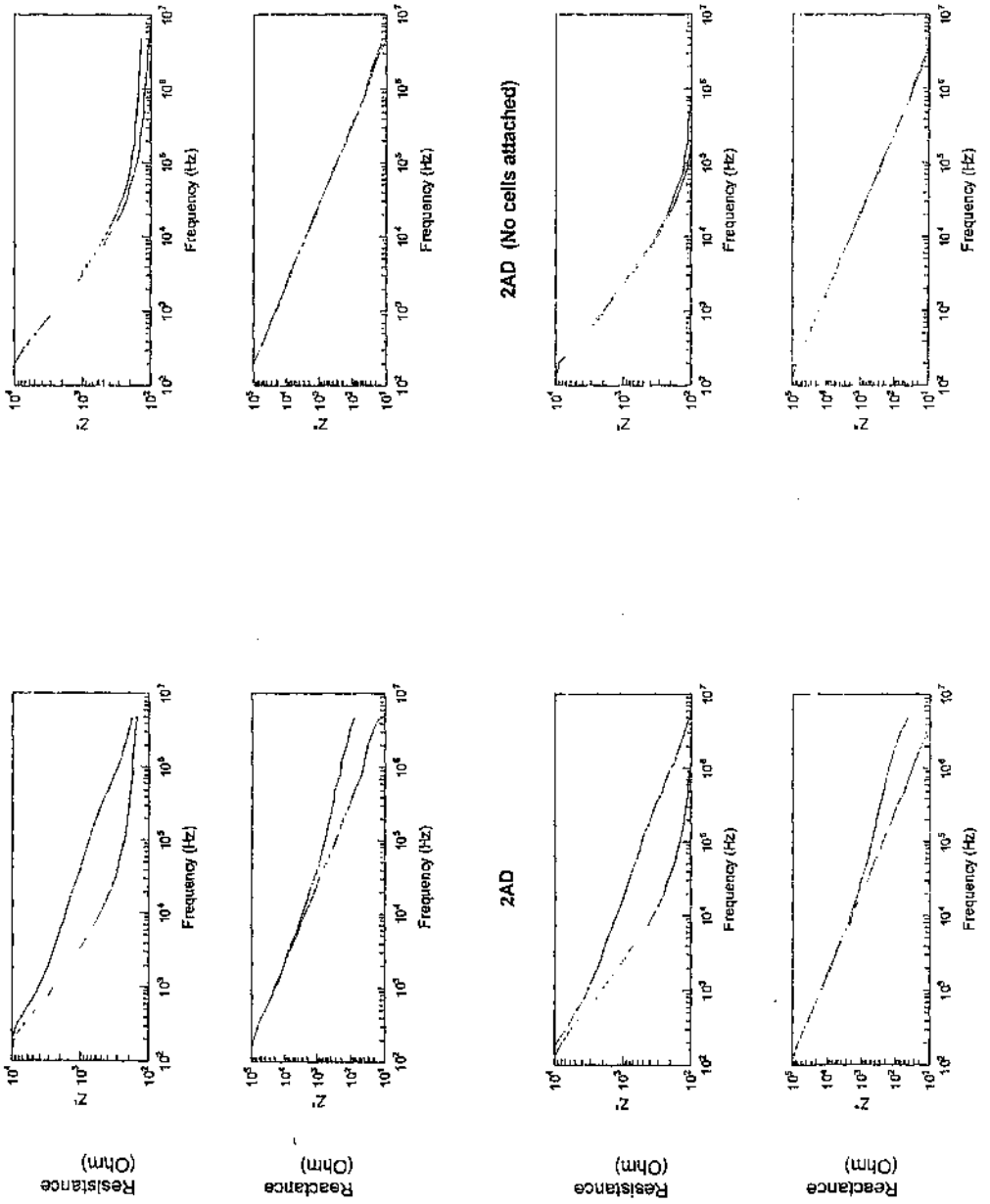

2AC
2AC No Cells attached
2AD
2AD (No cells attached)
Resistance (Ohm)
Reactance (Ohm)
Frequency (Hz)
|Z|

Figure 26A (3)

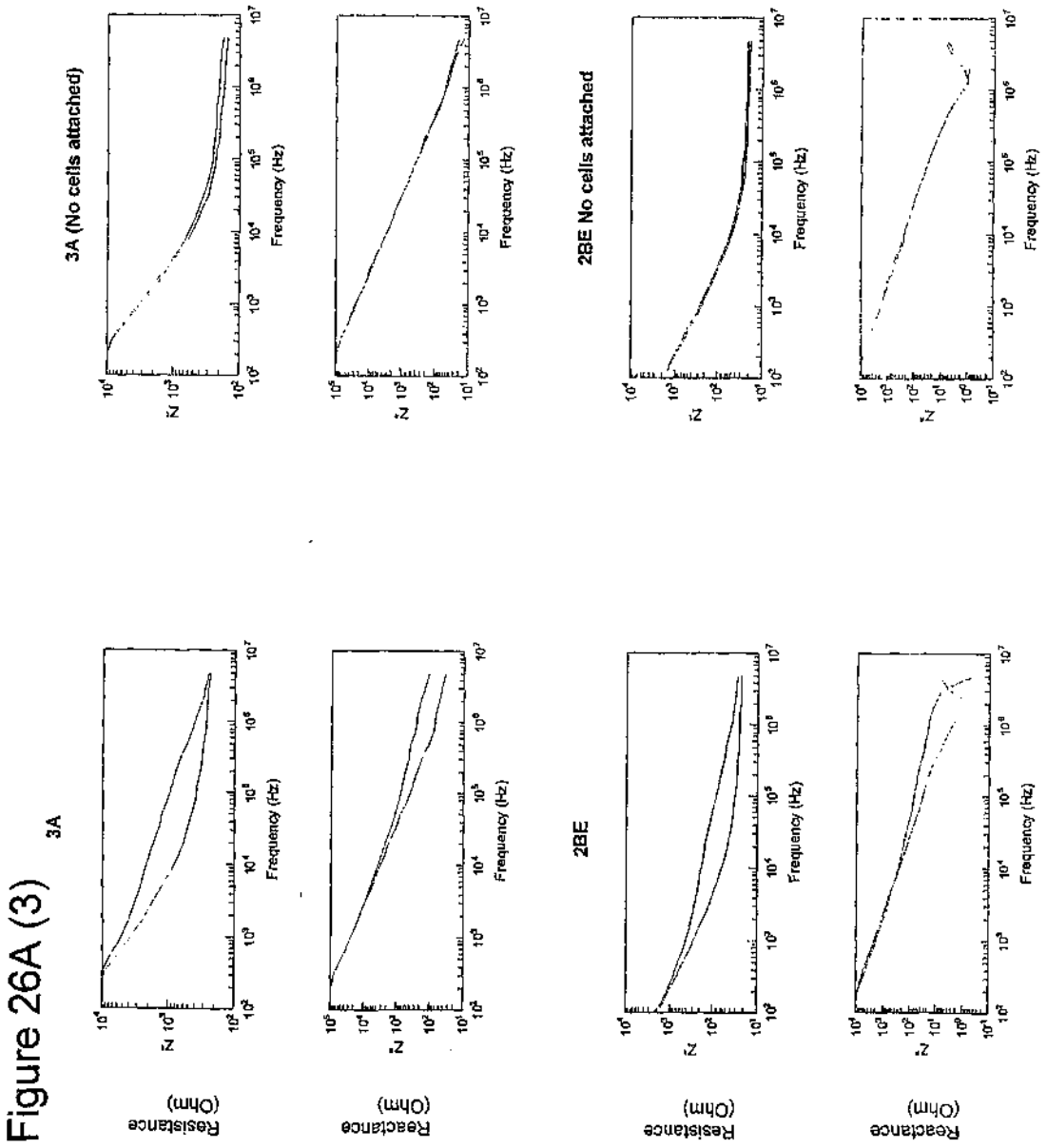

3A
3A (No cells attached)
2BE
2BE No cells attached
Resistance (Ohm)
Reactance (Ohm)
Frequency (Hz)
Z'
Z''

Figure 26A (4)

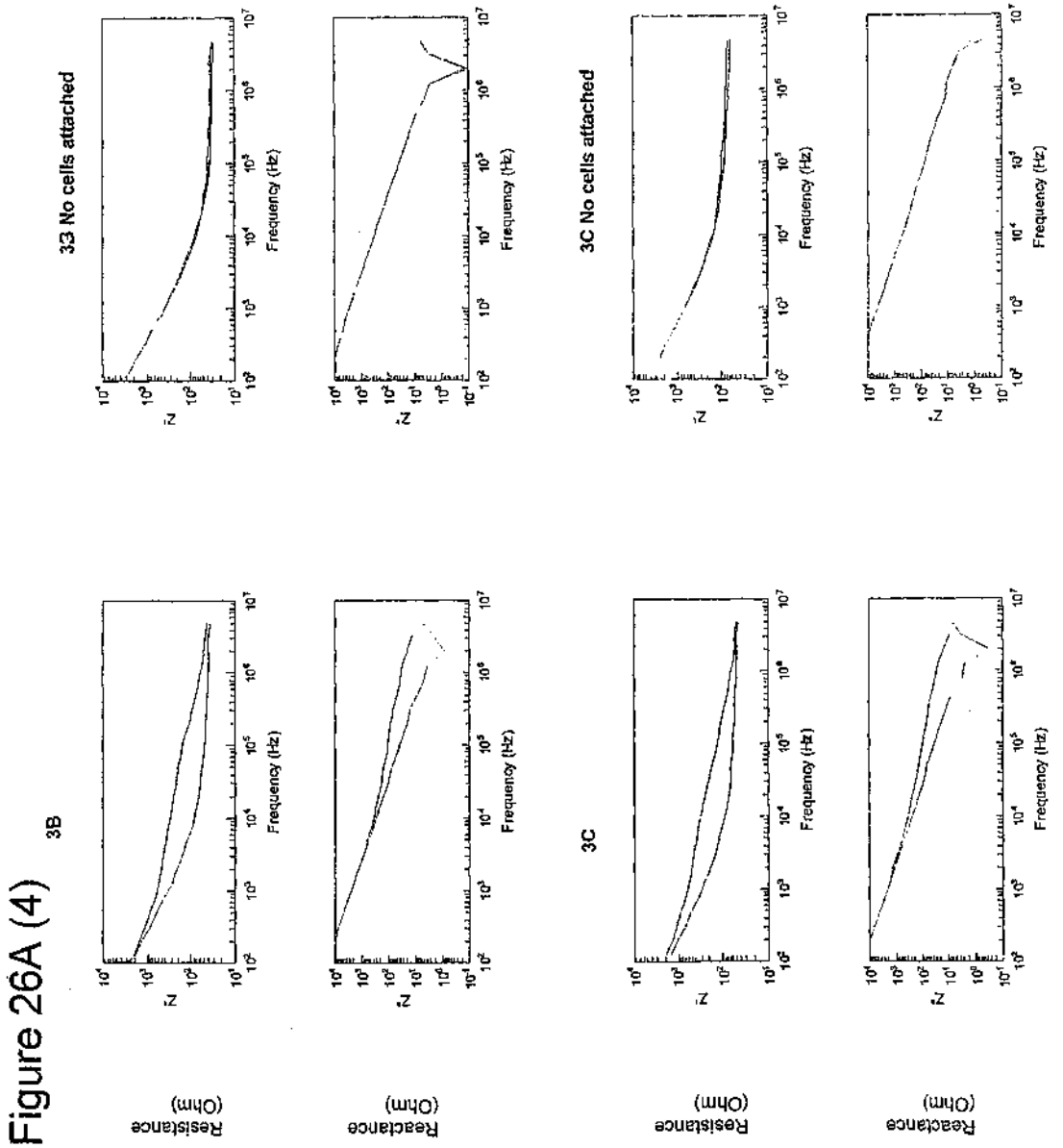
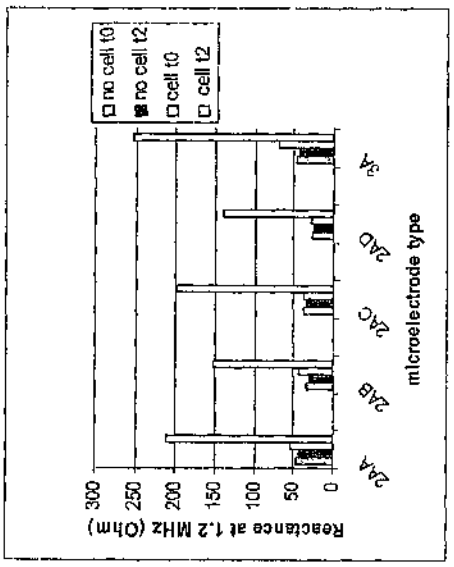
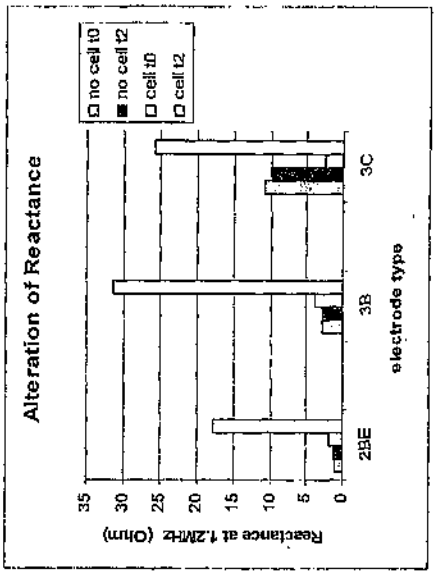
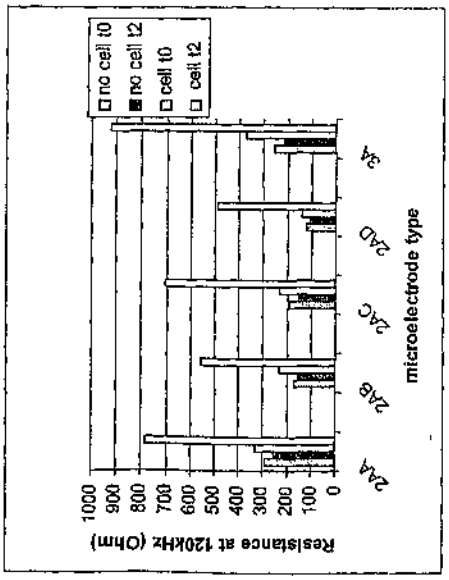

3B
3C
3B No cells attached
3C No cells attached
Resistance (Ohm)
Reactance (Ohm)
Frequency (Hz)
Z'
Z''

Figure 26B


Reactance at 1.2 MHz (Ohm)
microelectrode type
2AA
2AB
2AC
2AD
3A
no cell t0
no cell t2
cell t0
cell t2


Alteration of Reactance
Reactance at 1.2MHz (Ohm)
electrode type
2BE
3B
3C
no cell t0
no cell t2
cell t0
cell t2


Resistance at 120kHz (Ohm)
microelectrode type
2AA
2AB
2AC
2AD
3A
no cell t0
no cell t2
cell t0
cell t2

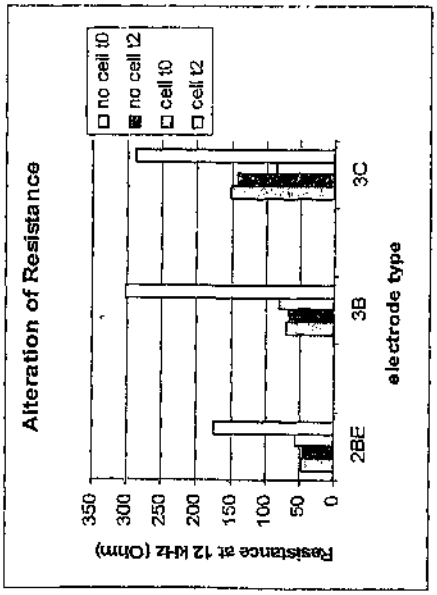
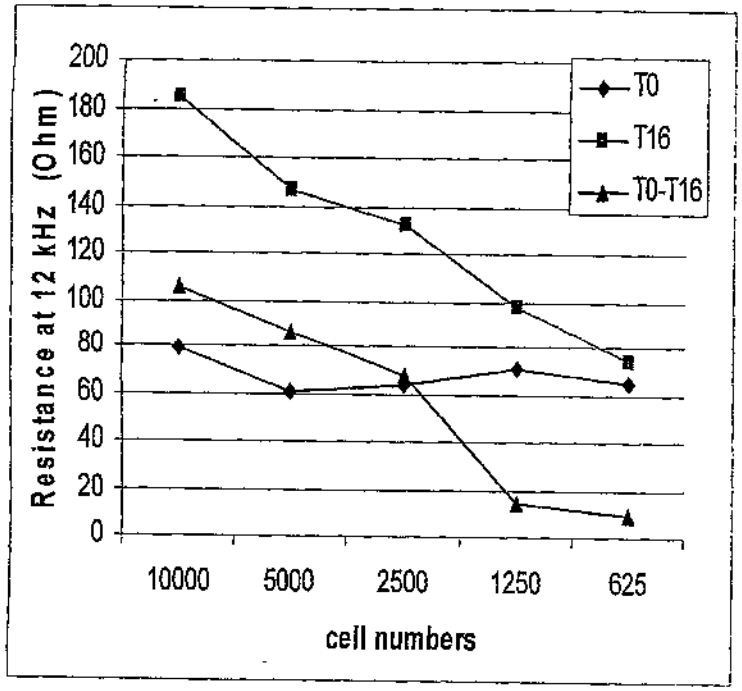

Alteration of Resistance
Resistance at 12 kHz (Ohm)
electrode type
2BE
3B
3C
no cell t0
no cell t2
cell t0
cell t2

Figure 27


Resistance at 12 kHz (Ohm)
200
180
160
140
120
100
80
60
40
20
0
T0
T16
T0-T16
10000
5000
2500
1250
625
cell numbers

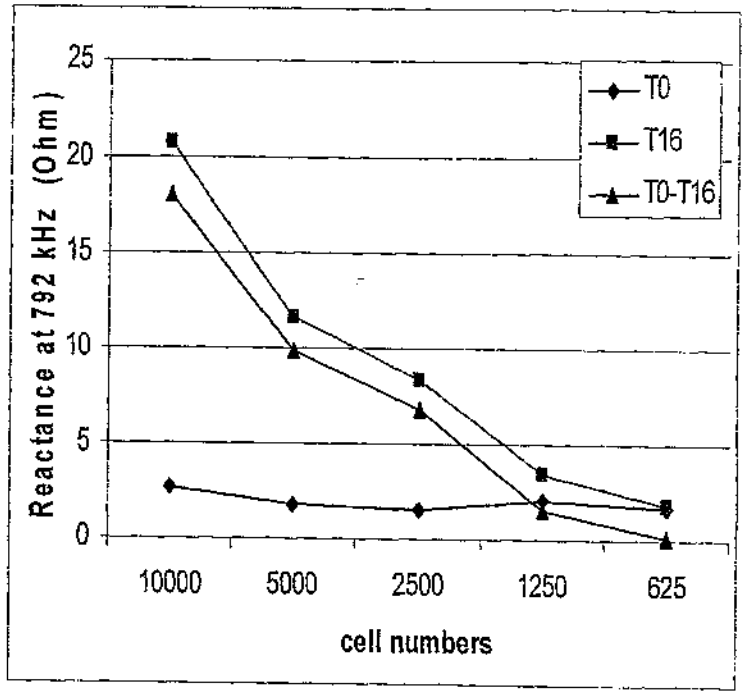
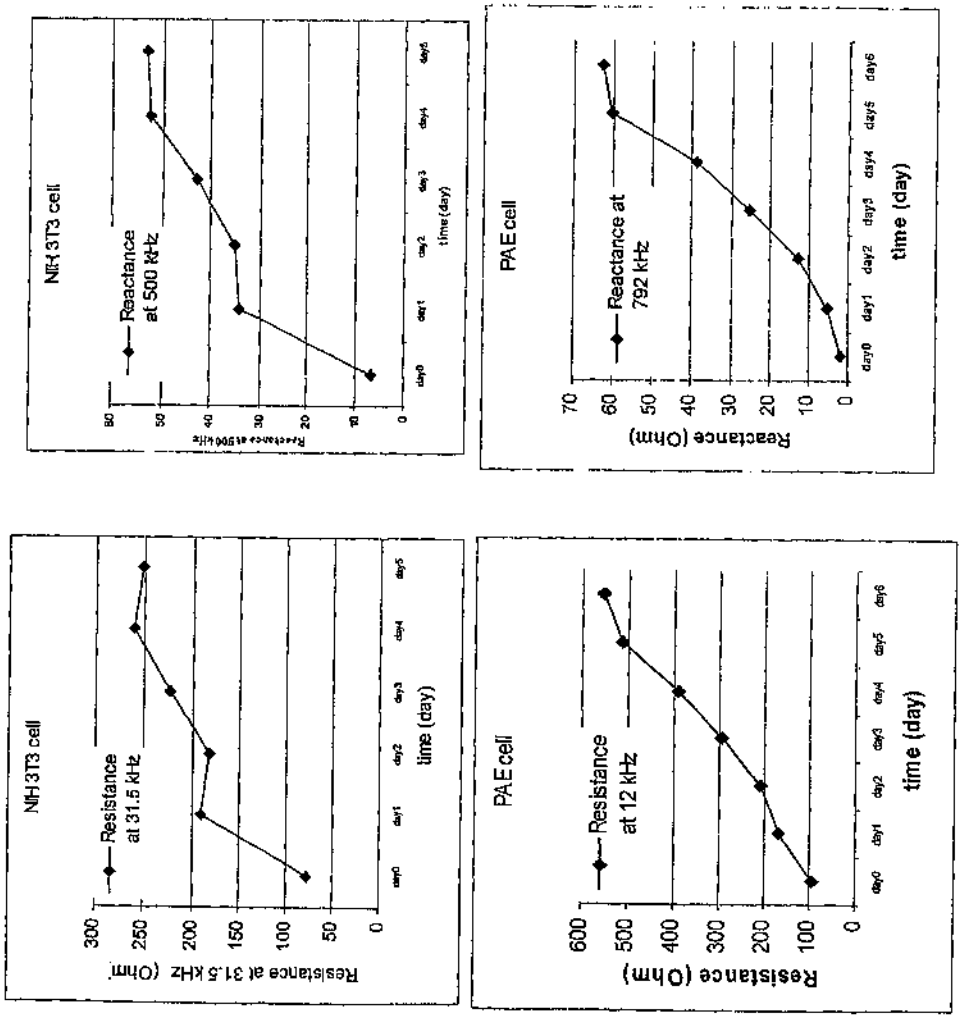

Reactance at 792 kHz (Ohm)
25
20
15
10
5
0
T0
T16
T0-T16
10000
5000
2500
1250
625
cell numbers

Figure 28


NIH 3T3 and PAE Cell Proliferation
NIH3T3 cell
Resistance at 31.5 kHz
Resistance at 31.5 kHz (Ohm)
time (day)
NIH3T3 cell
Reactance at 500 kHz
time (day)
PAE cell
Resistance at 12 kHz
Resistance (Ohm)
time (day)
PAE cell
Reactance at 792 kHz
Reactance (Ohm)
time (day)

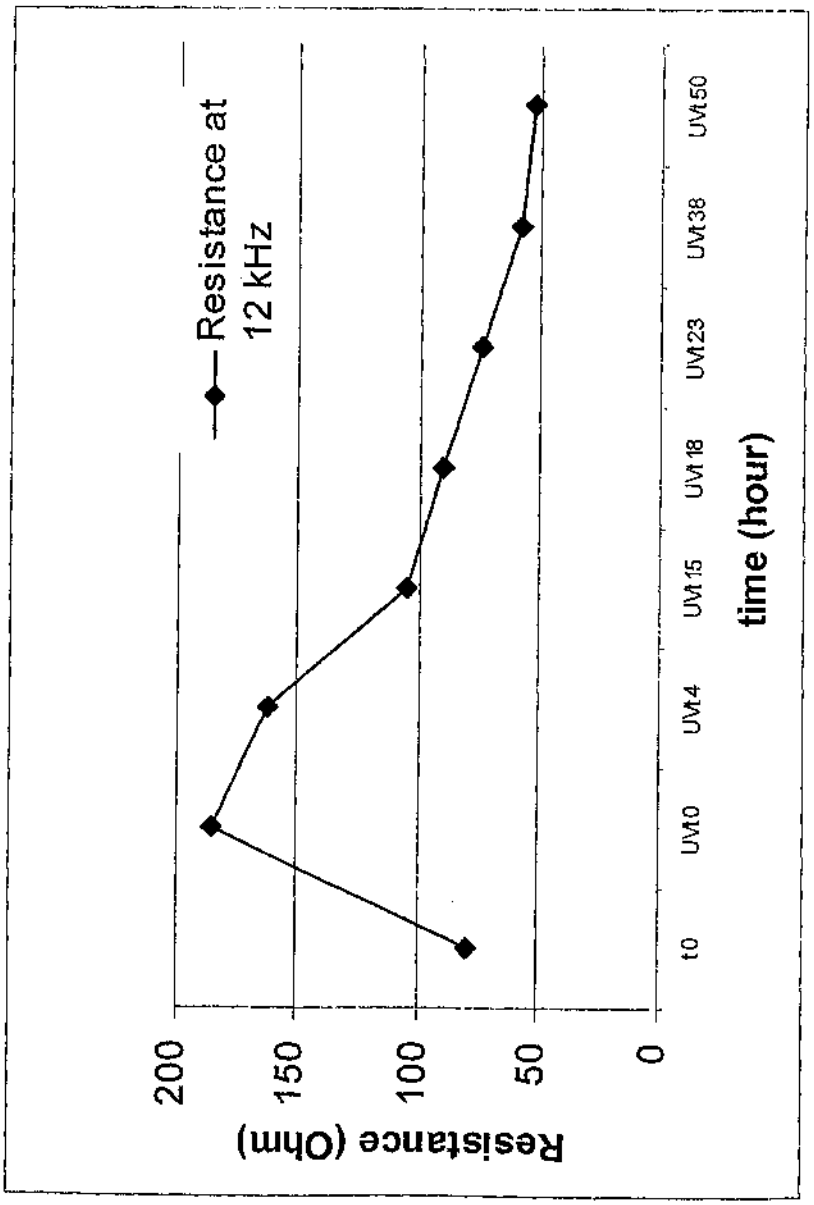
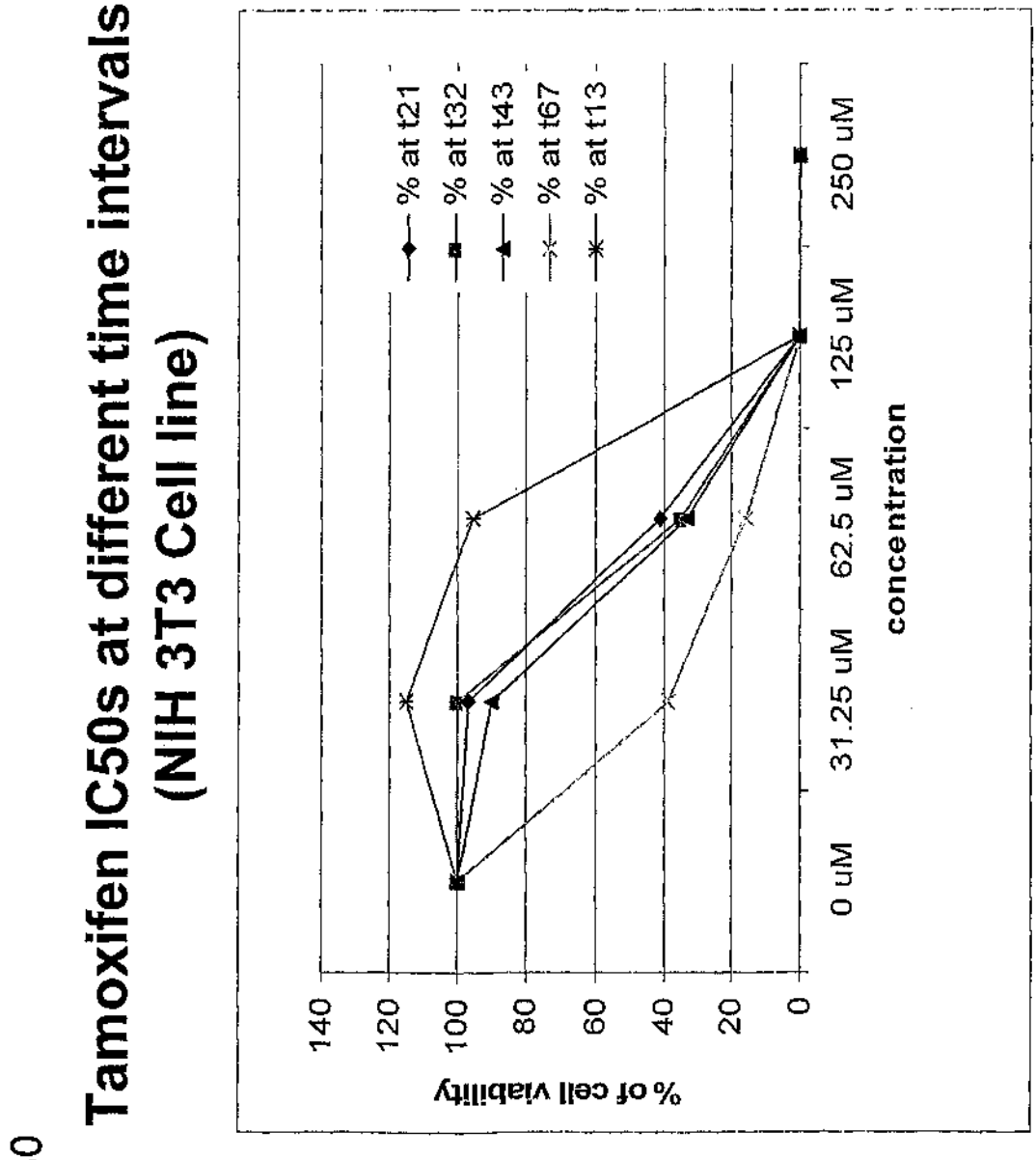

Resistance at
12 kHz
Resistance (Ohm)
200
150
100
50
0
t0
UVt0
UVt4
UVt15
UVt18
UVt23
UVt38
UVt50
time (hour)

Figure 29

Figure 30


Tamoxifen IC50s at different time intervals
(NIH 3T3 Cell line)
% of cell viability
140
120
100
80
60
40
20
0
0 uM
31.25 uM
62.5 uM
125 uM
250 uM
concentration
% at t21
% at t32
% at t43
% at t67
% at t13

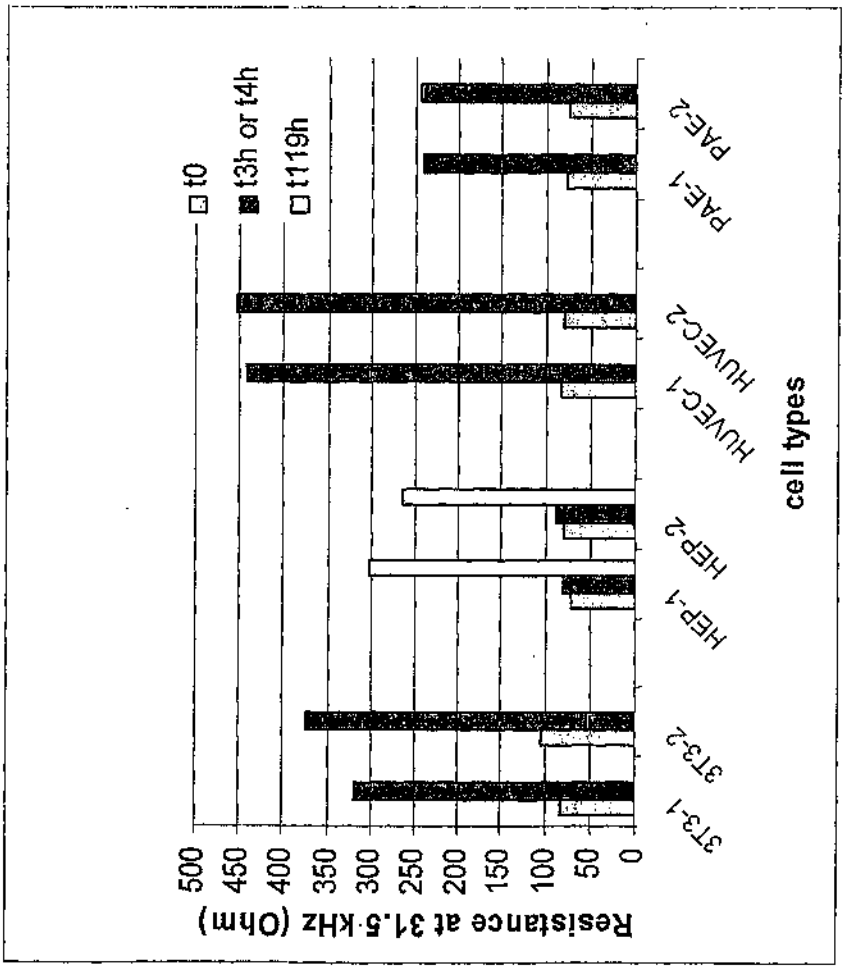

Resistance at 31.5 kHz (Ohm)
500
450
400
350
300
250
200
150
100
50
0
3T3-1
3T3-2
HEP-1
HEP-2
HUVEC-1
HUVEC-2
PAE-1
PAE-2
cell types
t0
t3h or t4h
t119h

Figure 31

Figure 32

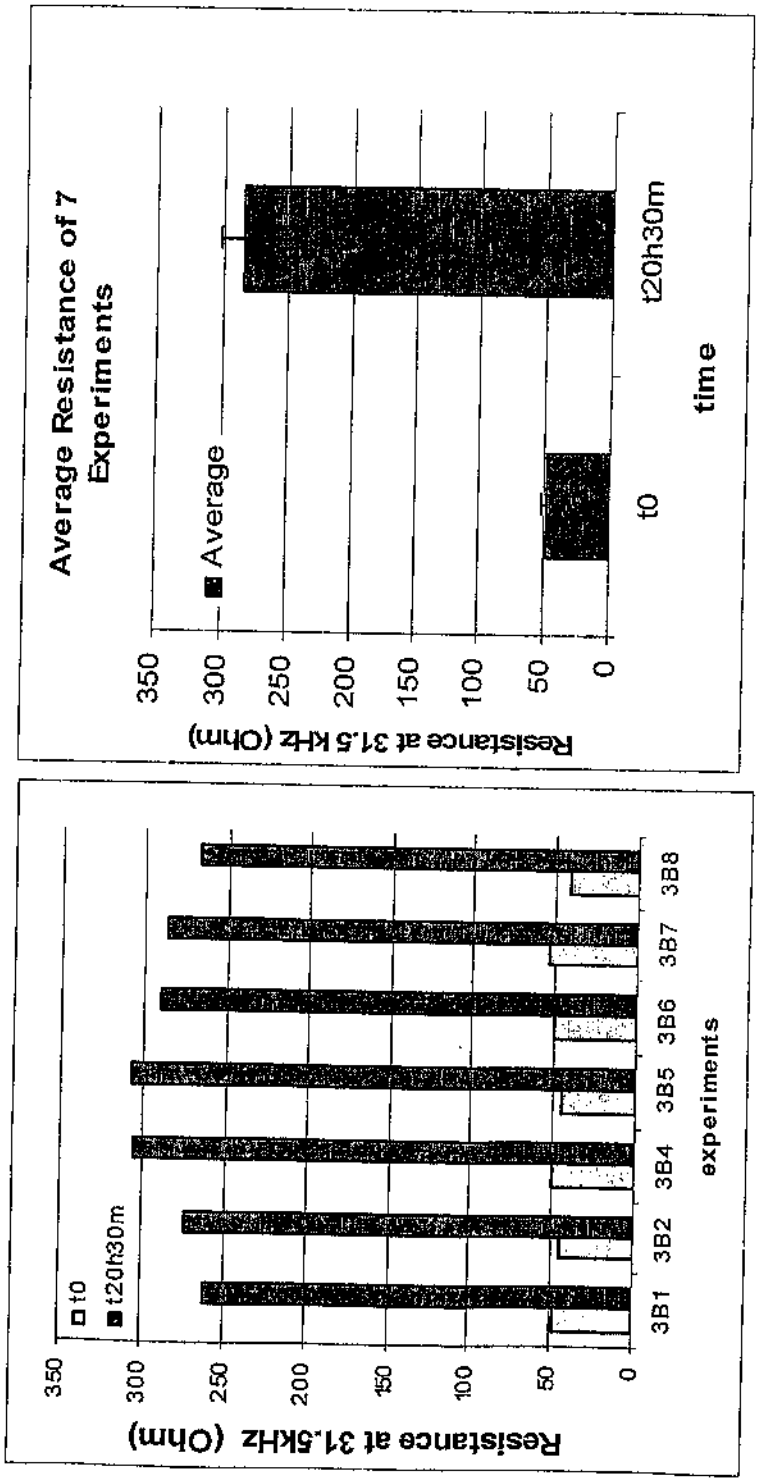

Average Resistance of 7 Experiments
Average
Resistance at 31.5 kHz (Ohm)
350
300
250
200
150
100
50
0
t0
t20h30m
time
Resistance at 31.5kHz (Ohm)
t0
t20h30m
3B1
3B2
3B4
3B5
3B6
3B7
3B8
experiments

Figure 33.

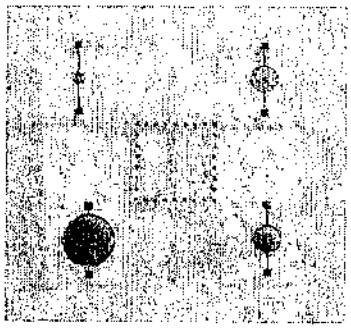


Figure 34.

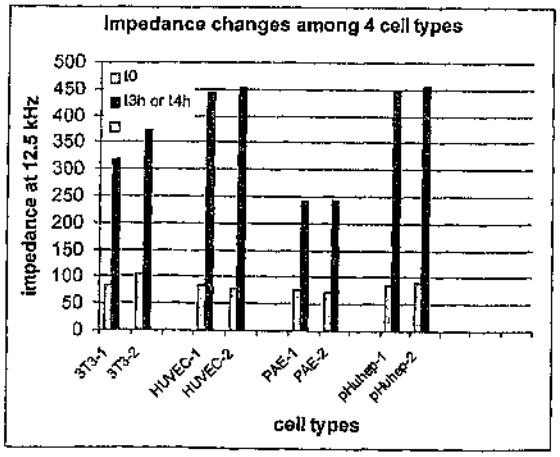


Figure 35.

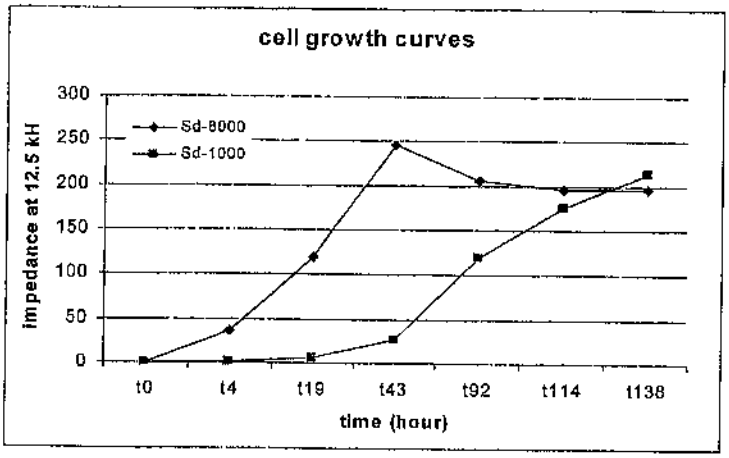


Figure 36.

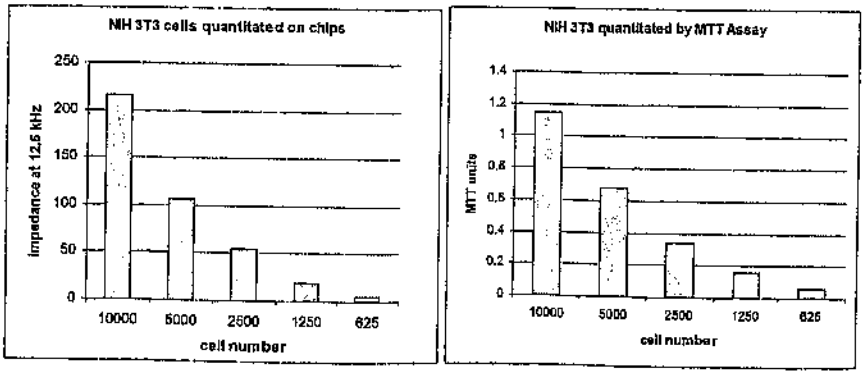
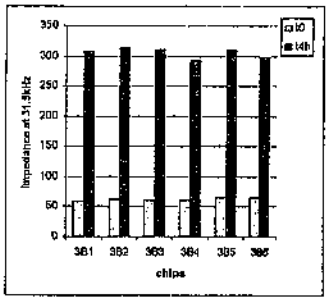


Figure 37.


350
300
250
200
150
100
50
0
t0
t4h
chips

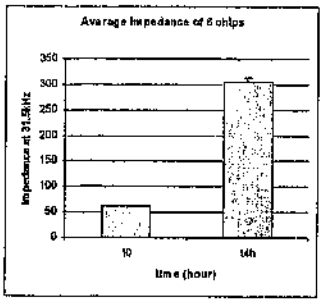

Average Impedance of 6 chips
350
300
250
200
150
100
50
0
10
t4h
time (hour)

Figure 38(A).

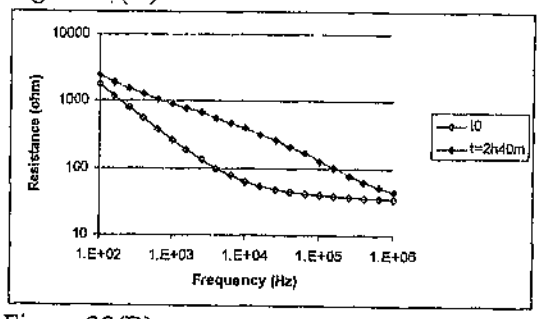


Figure 38(B)

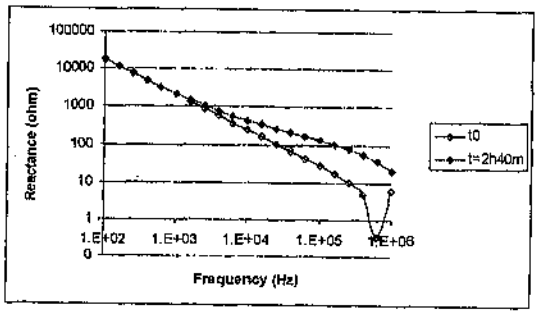


Figure 38(C)

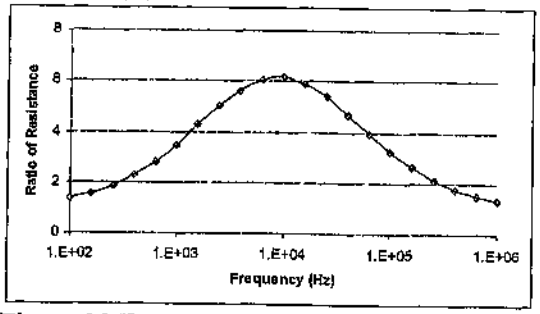


Figure 38(D)

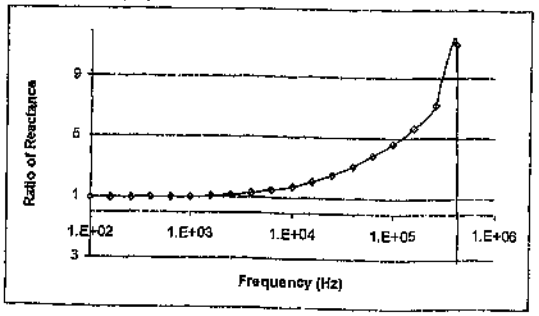


Figure 39(A)

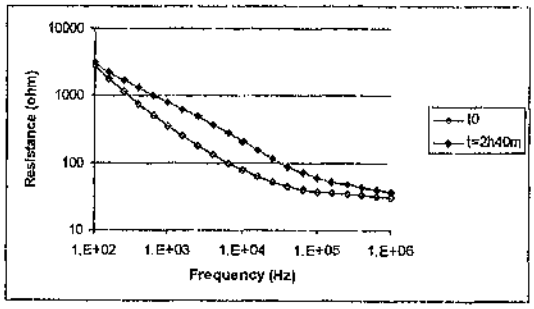


Figure 39(B)

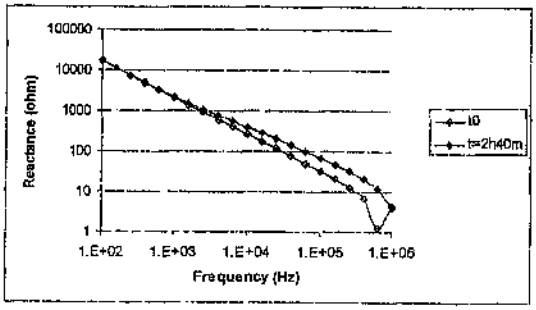


Figure 39(C)

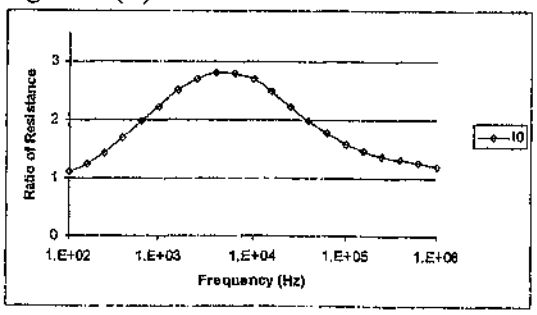


Figure 39(D)

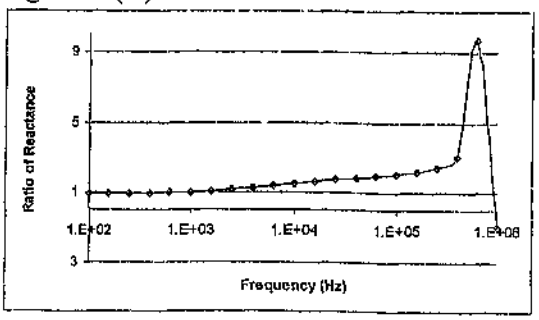


Figure 40(A)

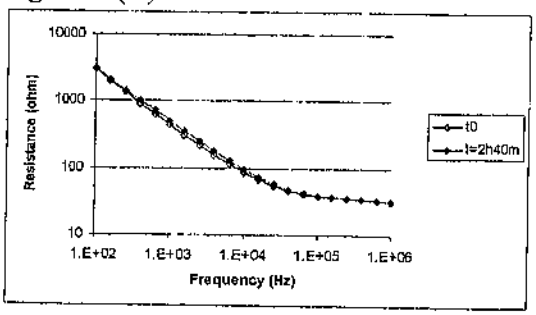


Figure 40(B)

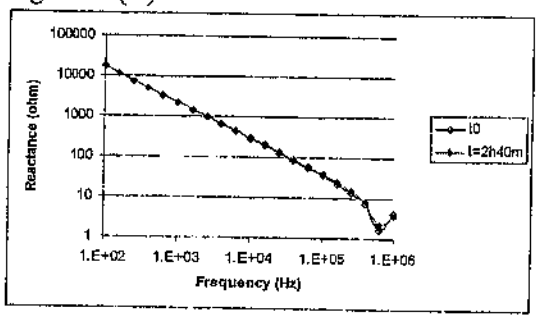


Figure 40(C)

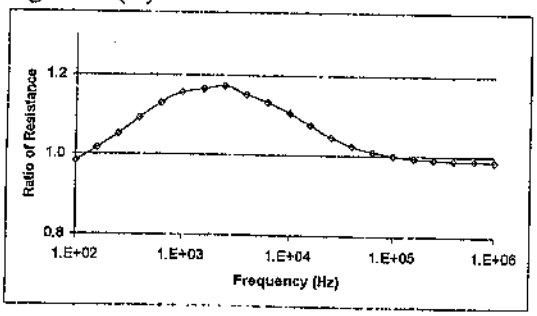


Figure 40(D)

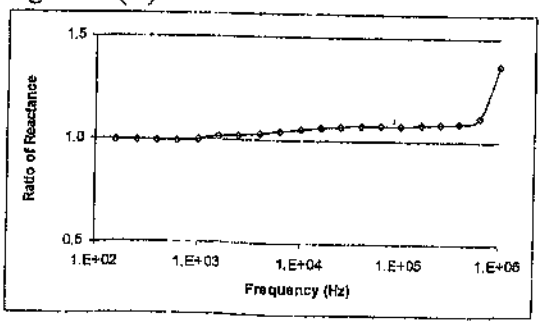


Figure 41(A)

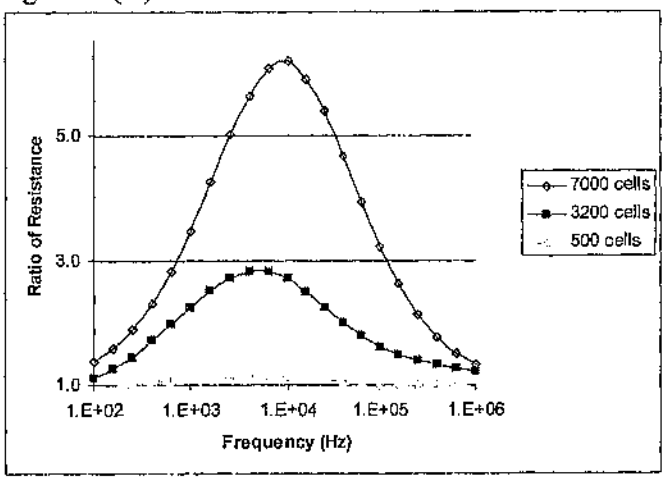


Figure 41(B)

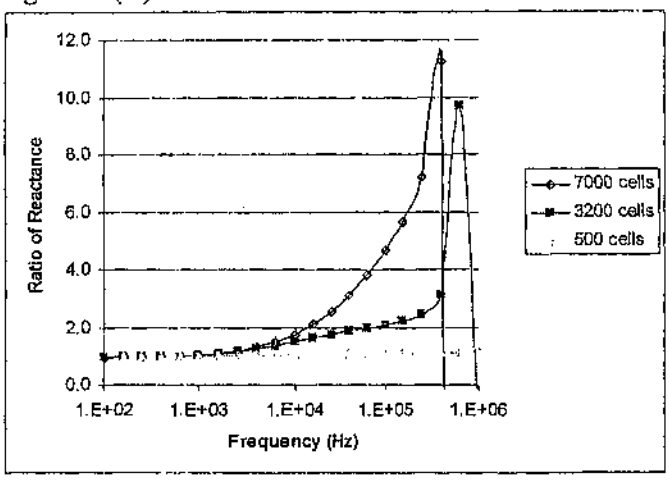


Figure 42 A

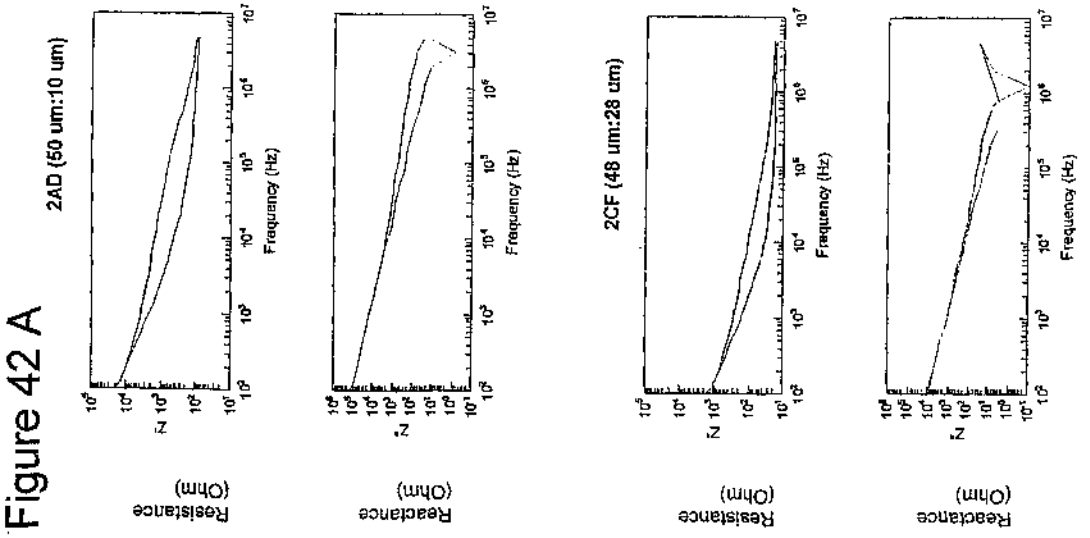

2AD (50 um:10 um)
2BE (48 um: 18 um)
2CF (48 um:28 um)
50 um : 50 um
Resistance (Ohm)
Reactance (Ohm)
Frequency (Hz)
Z'
Z''

Figure 42 B

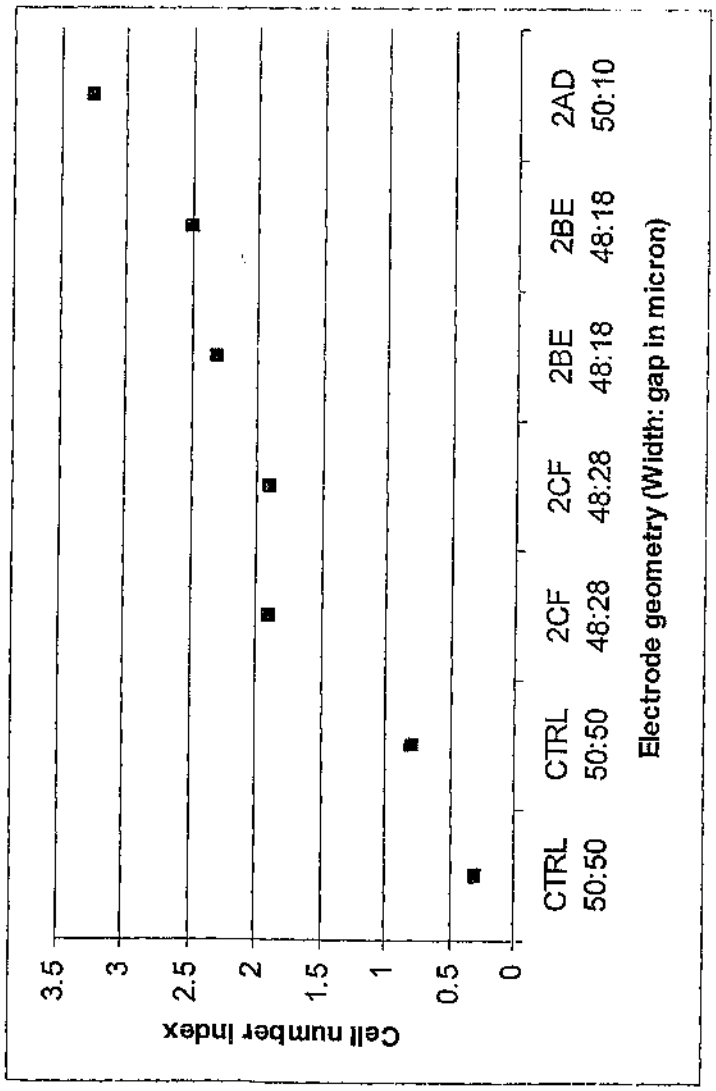

Cell number Index
3.5
3
2.5
2
1.5
1
0.5
0
CTRL 50:50
CTRL 50:50
2CF 48:28
2CF 48:28
2BE 48:18
2BE 48:18
2AD 50:10
Electrode geometry (Width: gap in micron)

Figure 43

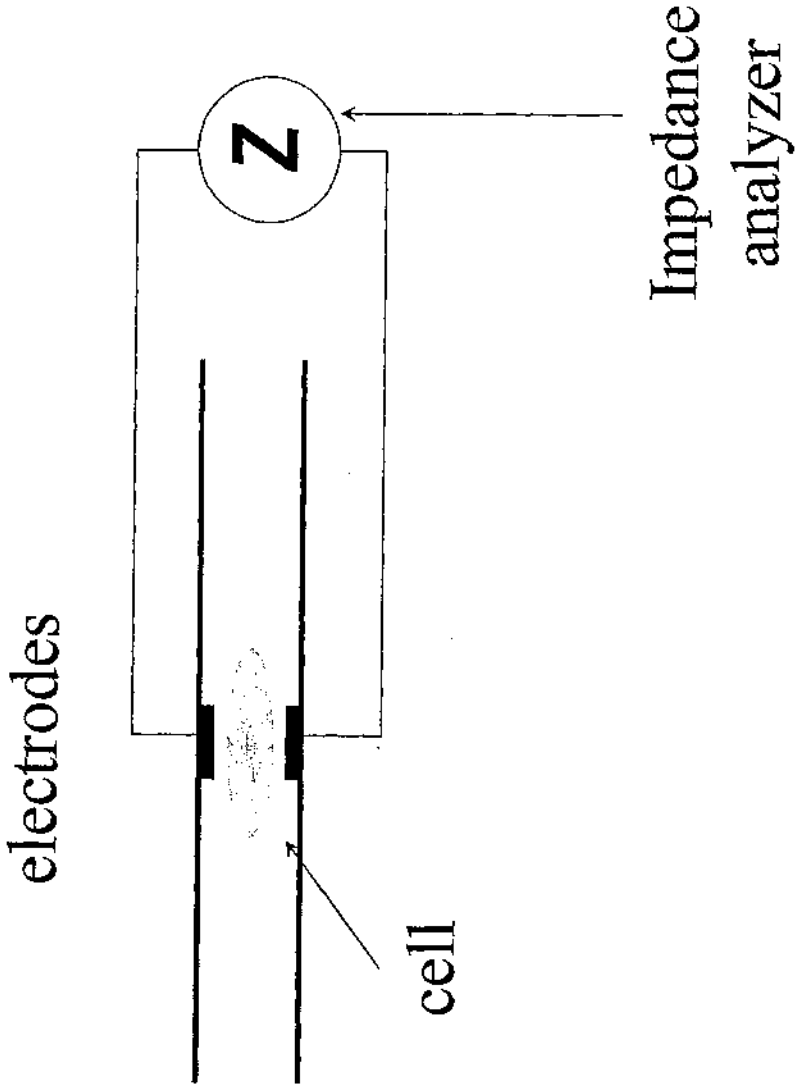


Figure 44

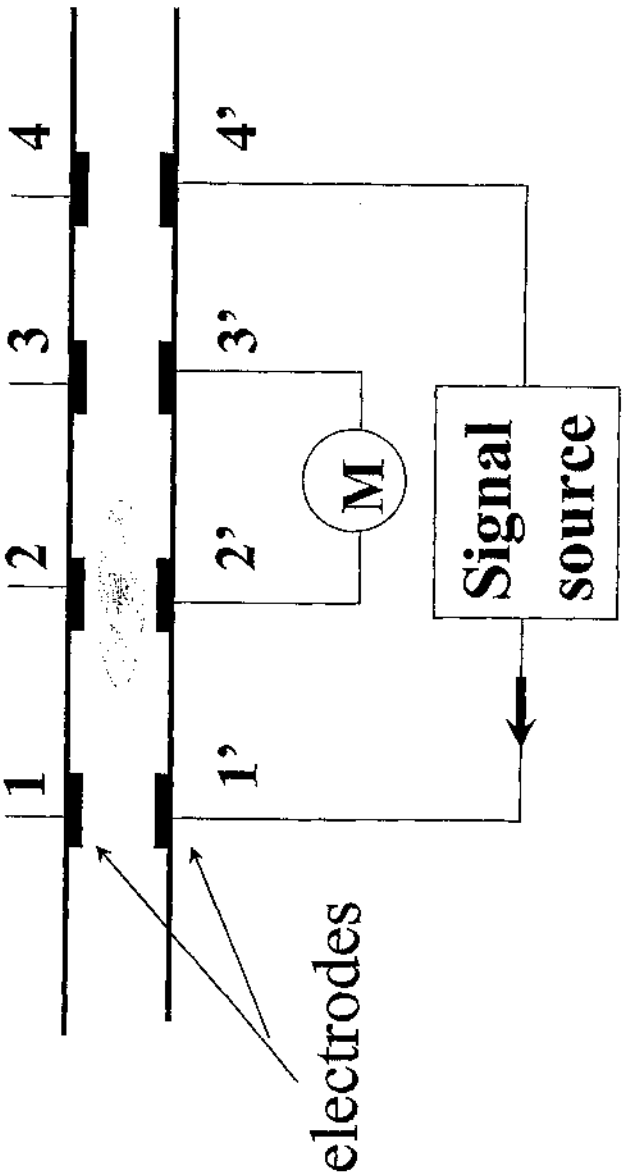
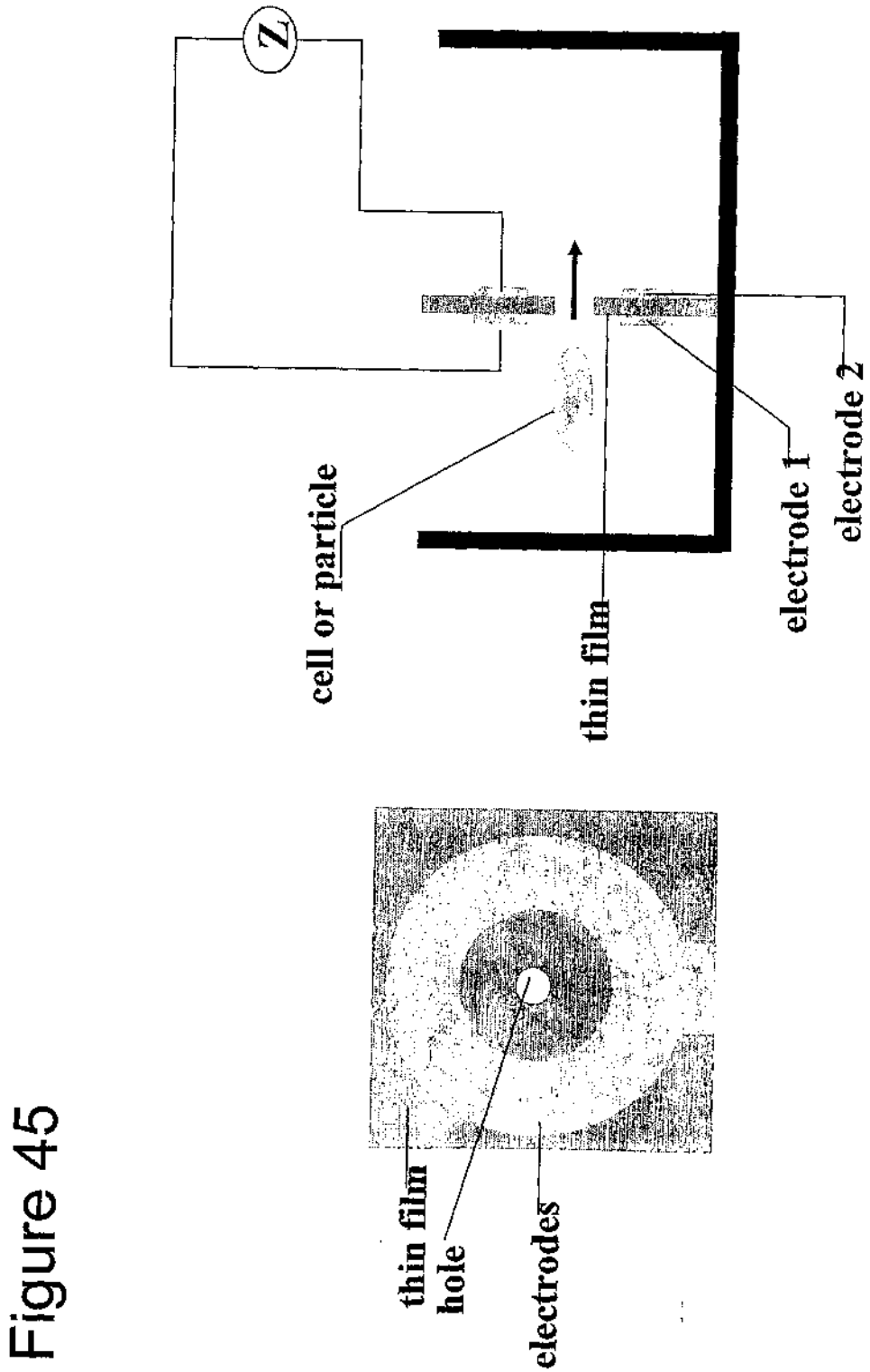


Figure 45


Z
cell or particle
thin film
electrode 1
electrode 2
thin film
hole
electrodes

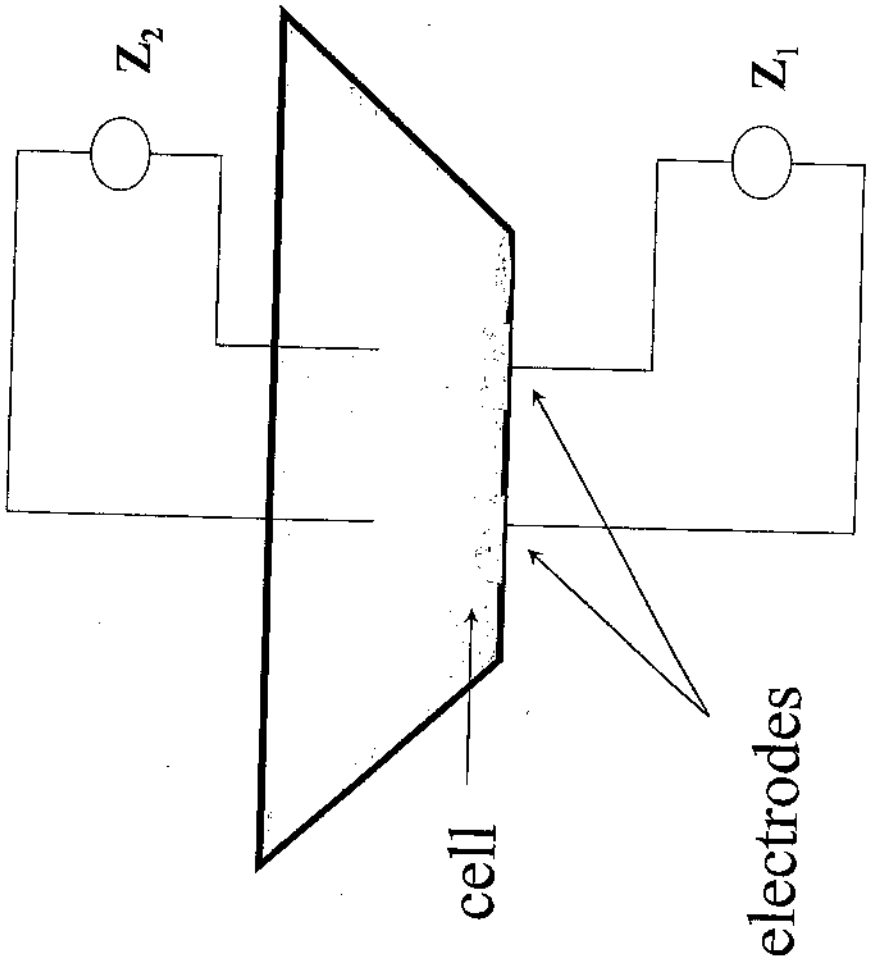


Figure 46