FIG. 1

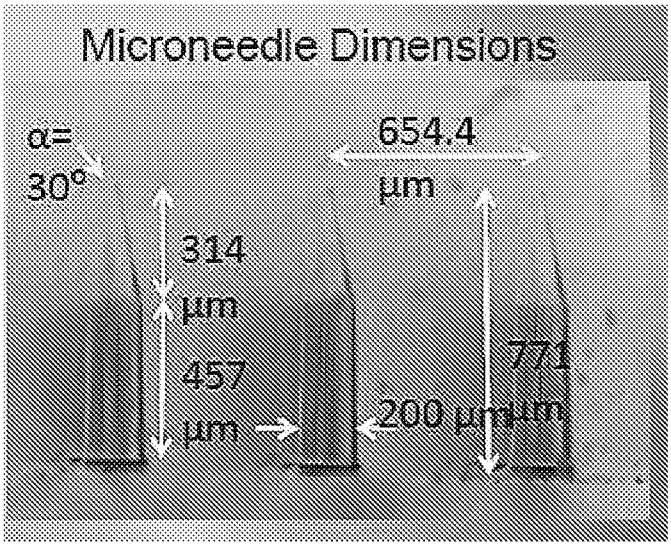

Microneedle Dimensions
α=
30°
654.4
µm
314
µm
457
µm
200 µm
771
µm

FIG. 2

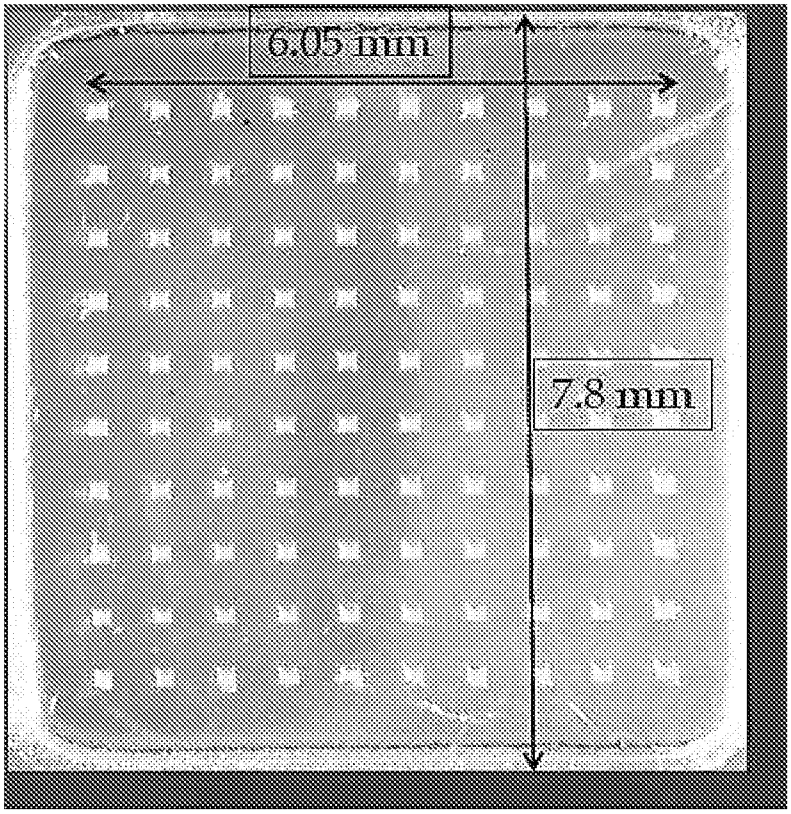

6.05 mm
7.8 mm

FIG. 3A

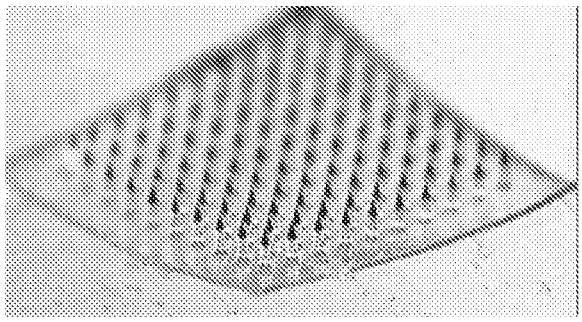


FIG. 3B

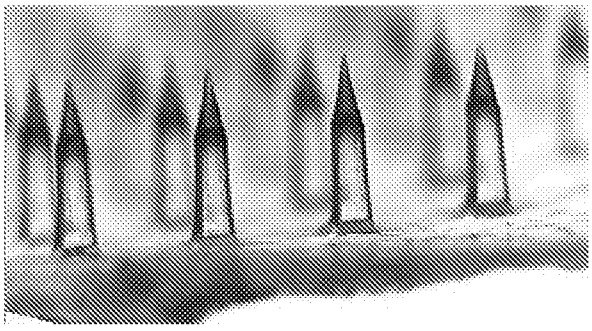


FIG. 4A

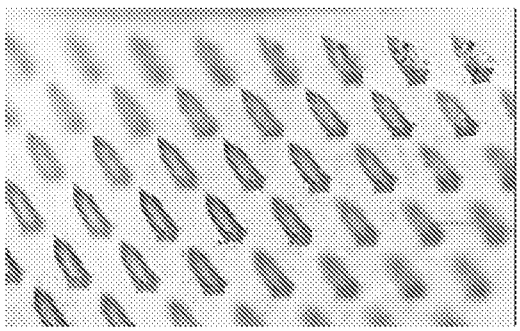


FIG. 4B



FIG. 5A

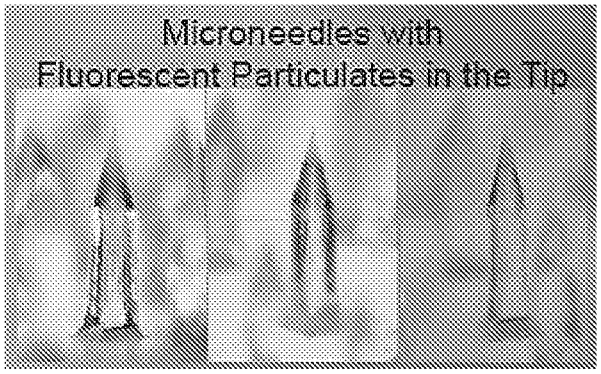


FIG. 5B

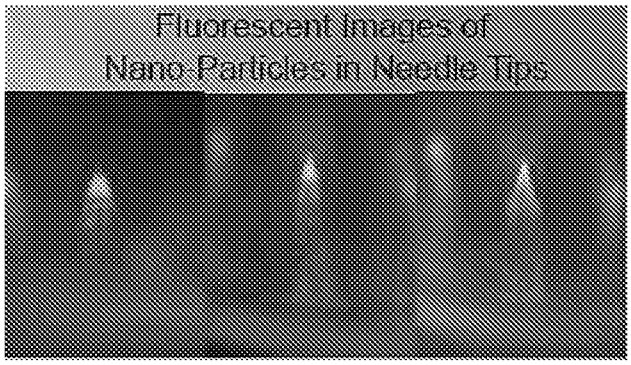


FIG. 6A

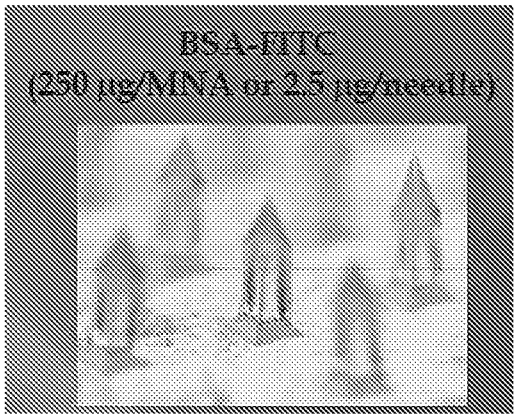


FIG. 6B

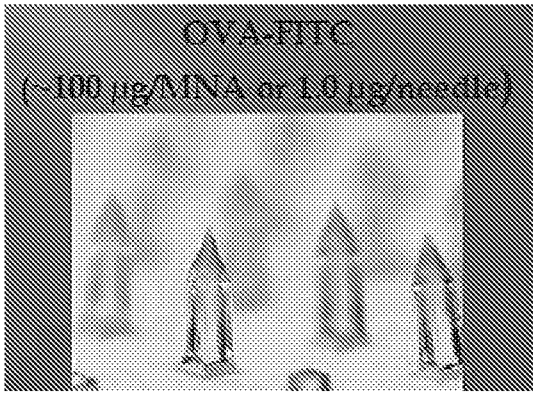


FIG. 7

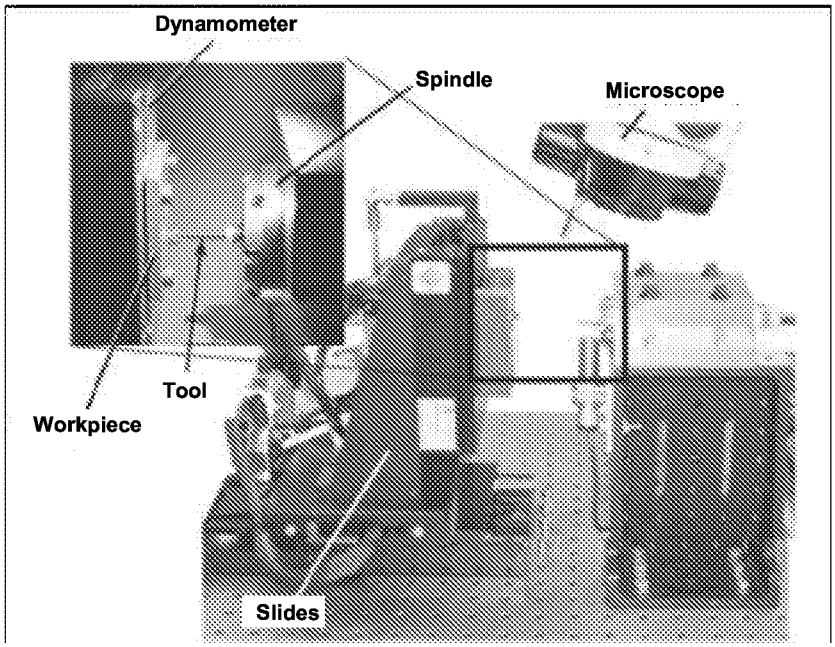

Dynamometer
Spindle
Microscope
Tool
Workpiece
Slides

FIG. 8

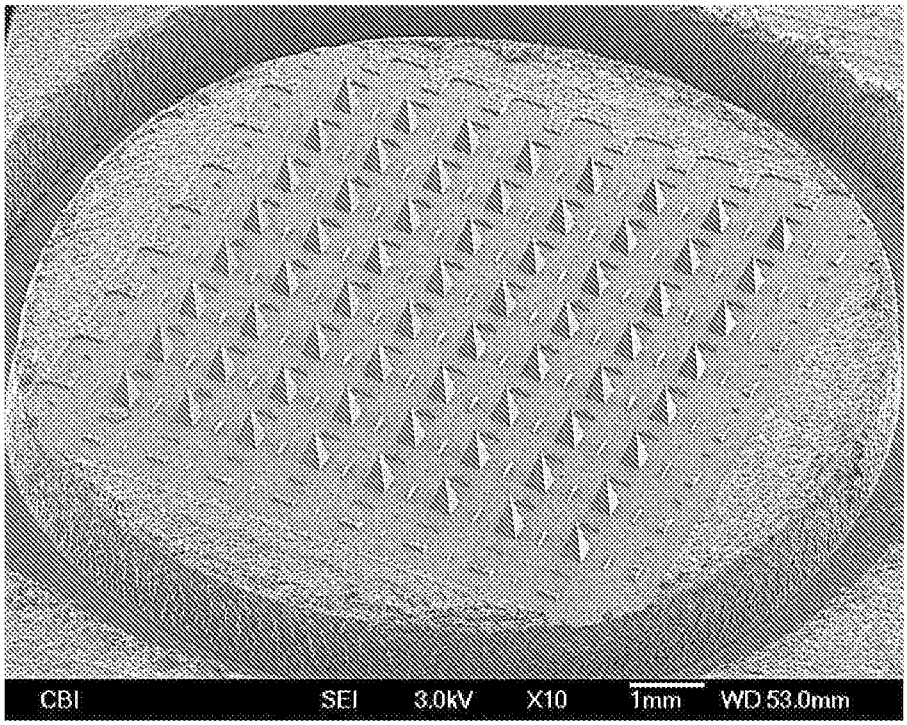

CBI
SEI
3.0kV
X10
1mm
WD 53.0mm

FIG. 9

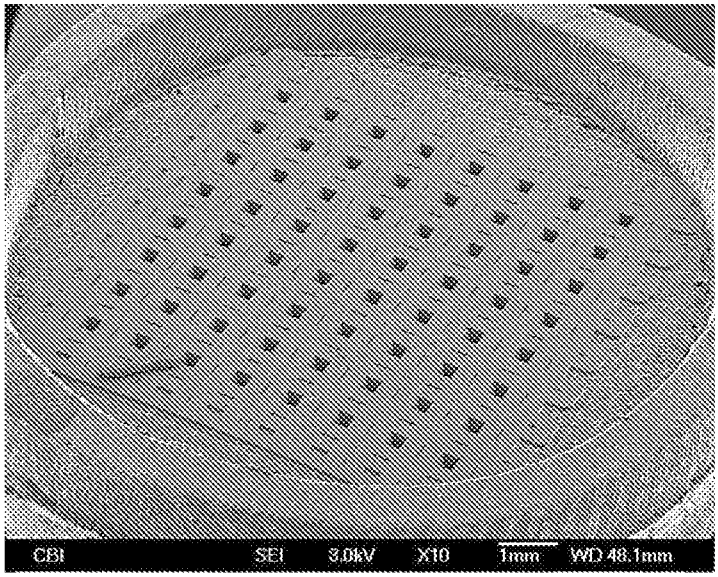
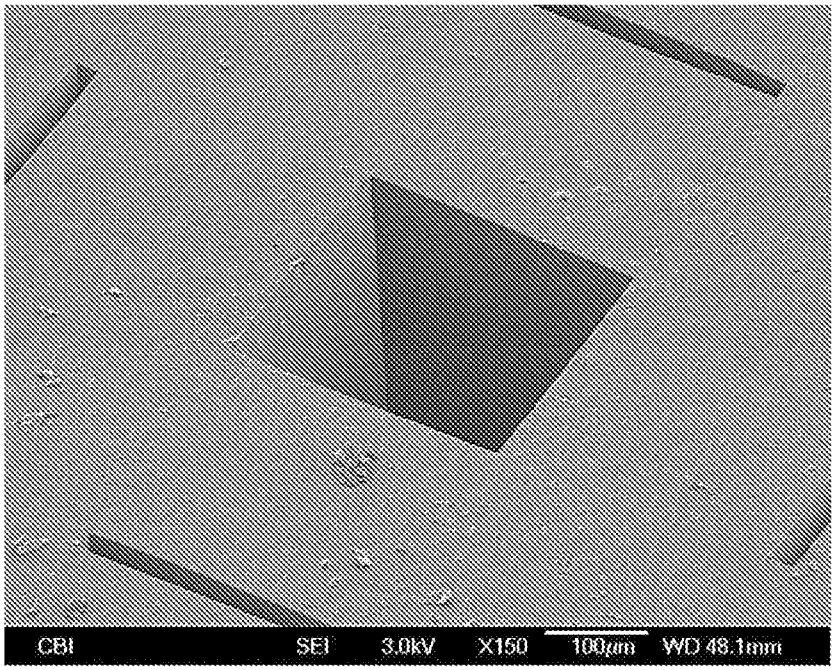


FIG. 10



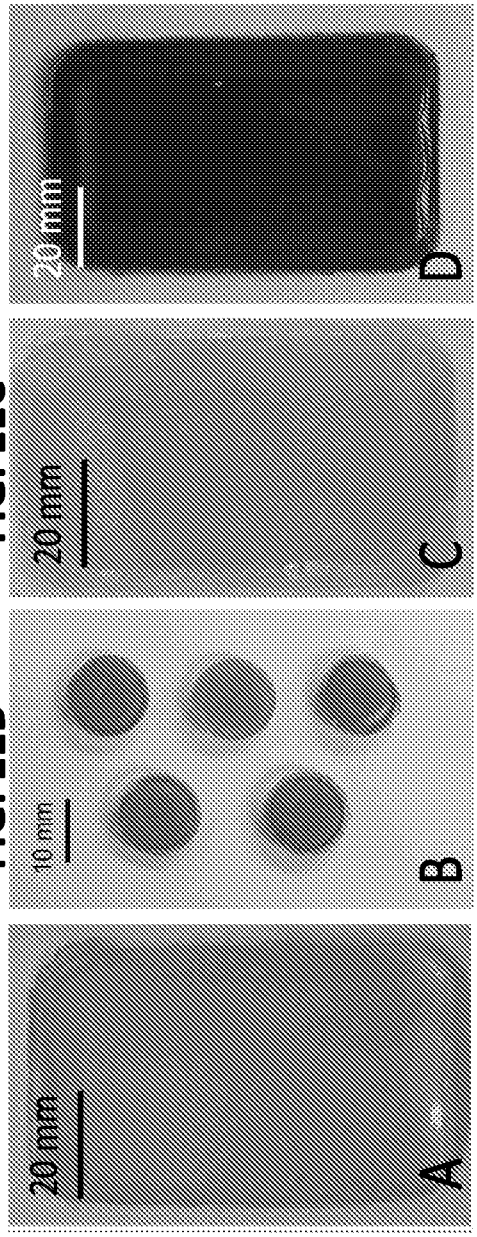


FIG. 11A

FIG. 11B

FIG. 11C

FIG. 11D

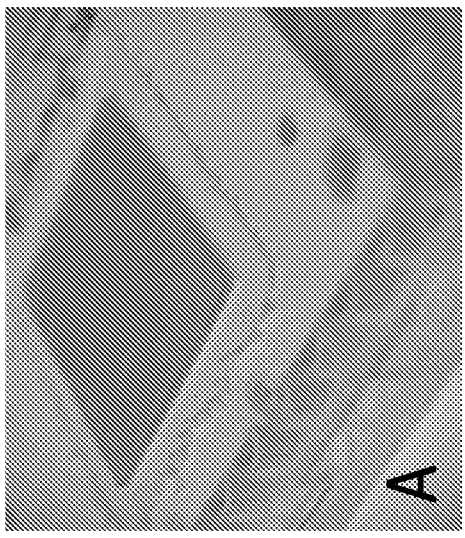


FIG. 12A

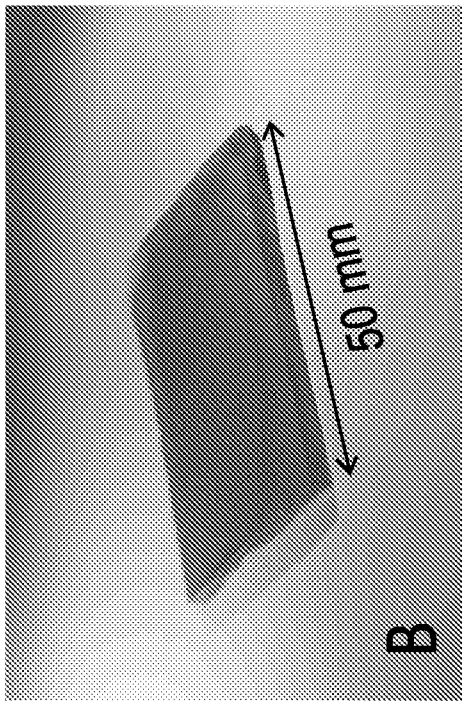


FIG. 12B

FIG. 13

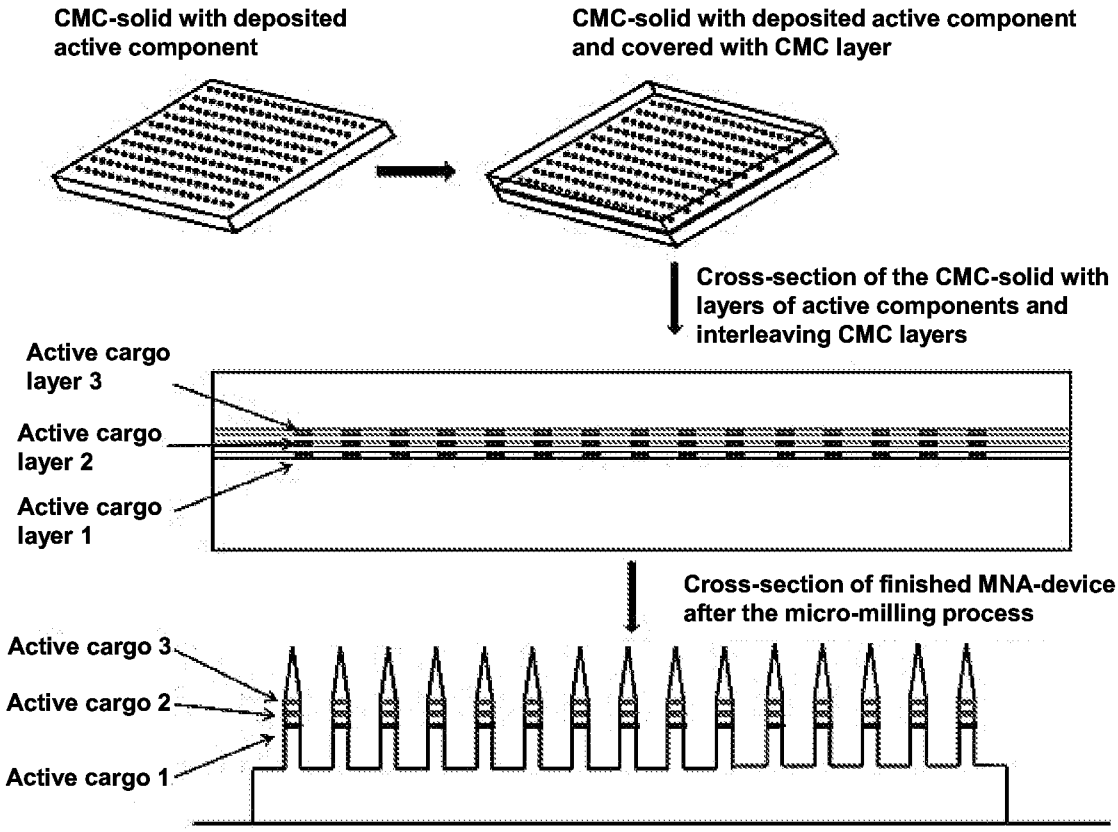

CMC-solid with deposited active component
CMC-solid with deposited active component and covered with CMC layer
Cross-section of the CMC-solid with layers of active components and interleaving CMC layers
Active cargo layer 3
Active cargo layer 2
Active cargo layer 1
Cross-section of finished MNA-device after the micro-milling process
Active cargo 3
Active cargo 2
Active cargo 1

FIG. 14

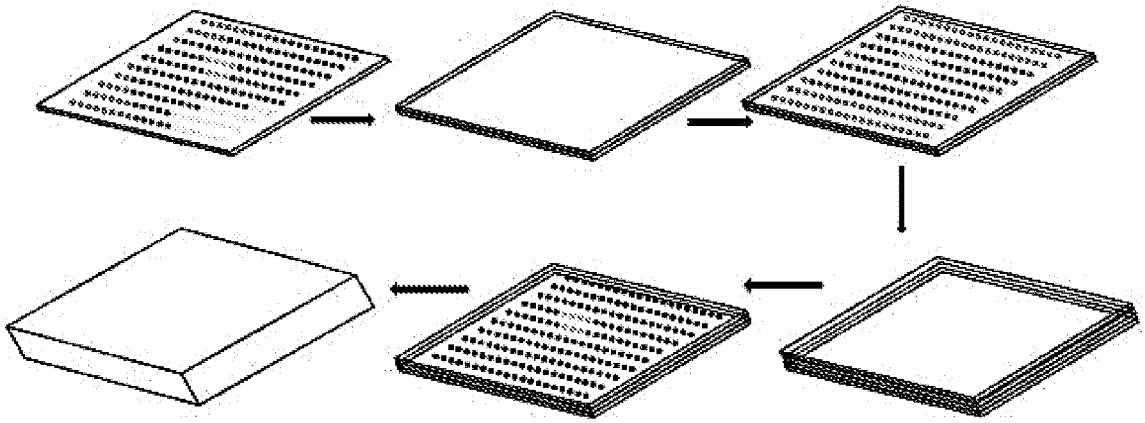


FIG. 15

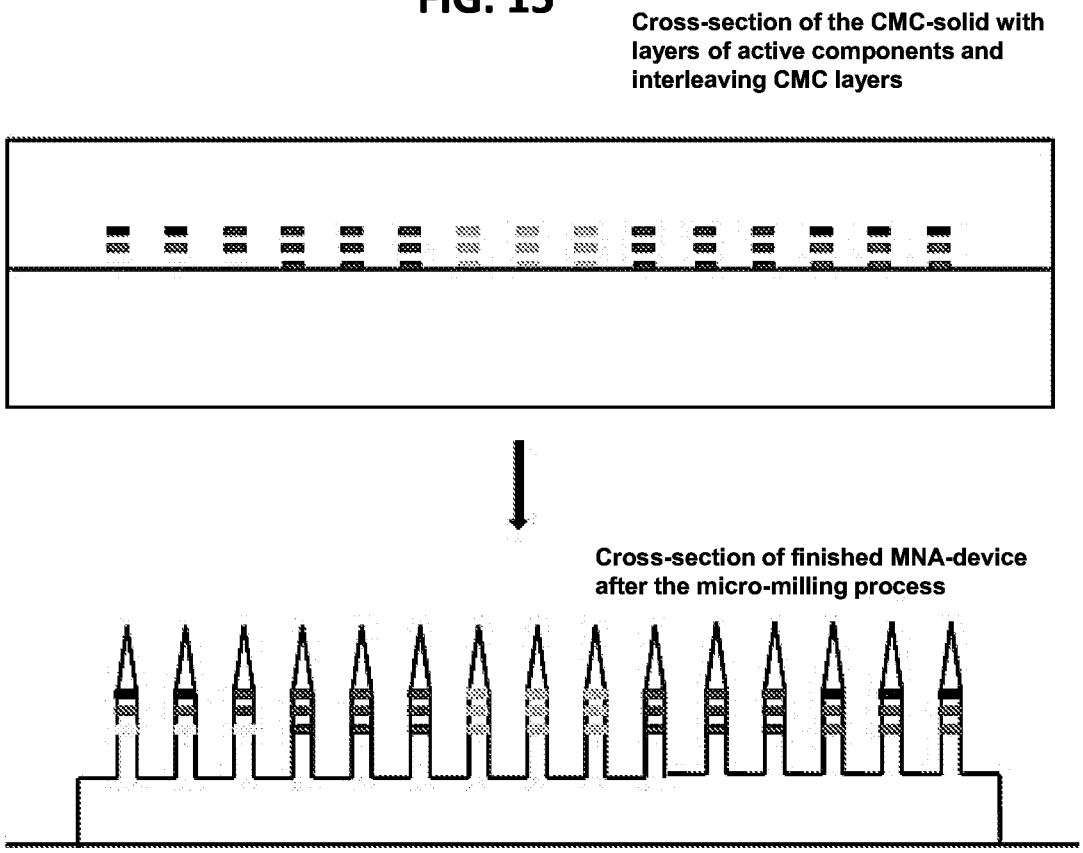

Cross-section of the CMC-solid with layers of active components and interleaving CMC layers
Cross-section of finished MNA-device after the micro-milling process

FIG. 16A

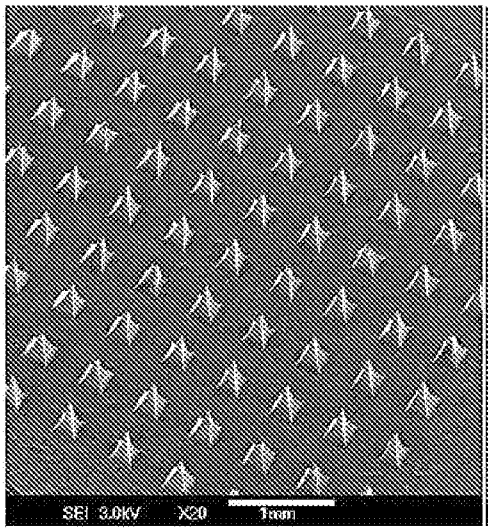


FIG. 16B

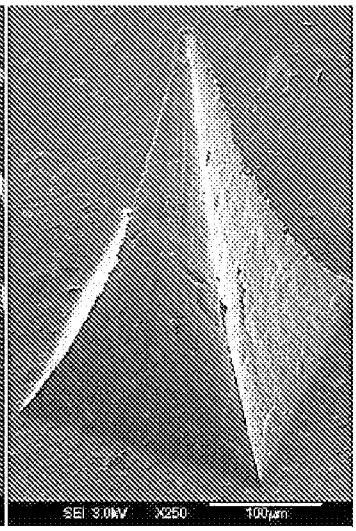


FIG. 17

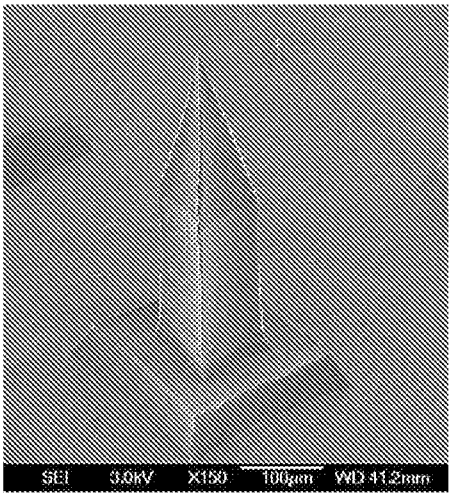


FIG. 18

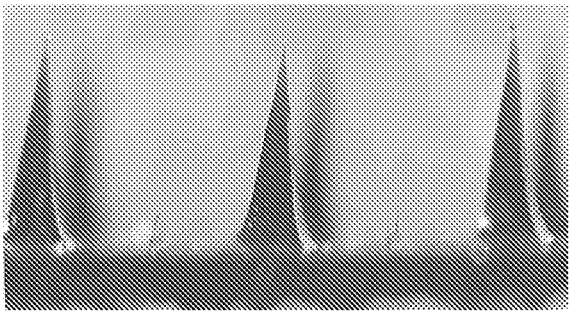


FIG. 19

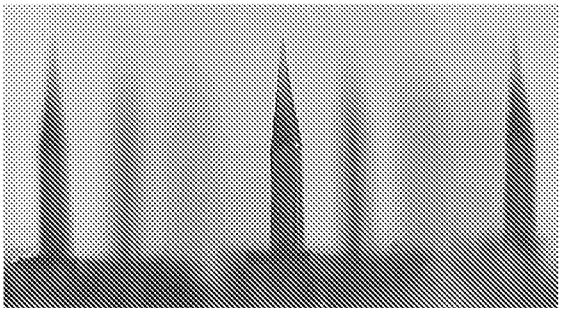


FIG. 20

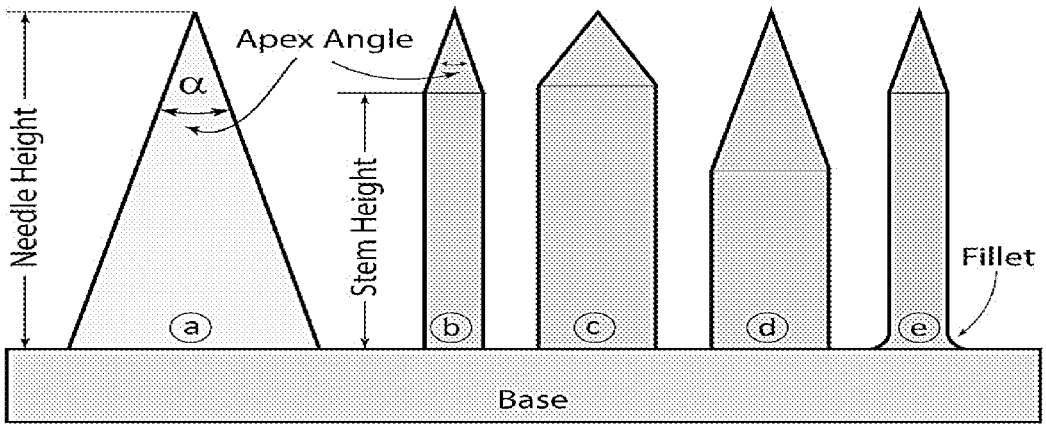


FIG. 21

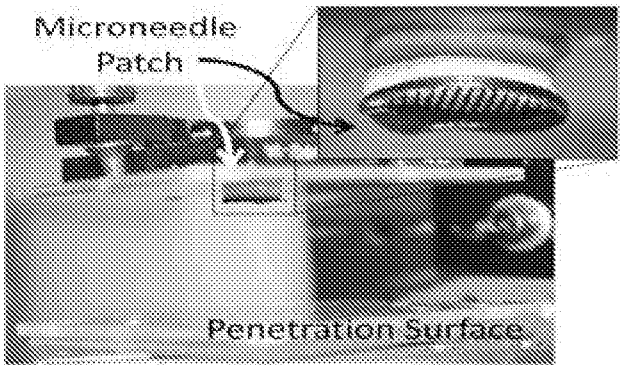

Microneedle
Patch
Penetration Surface

FIG. 22

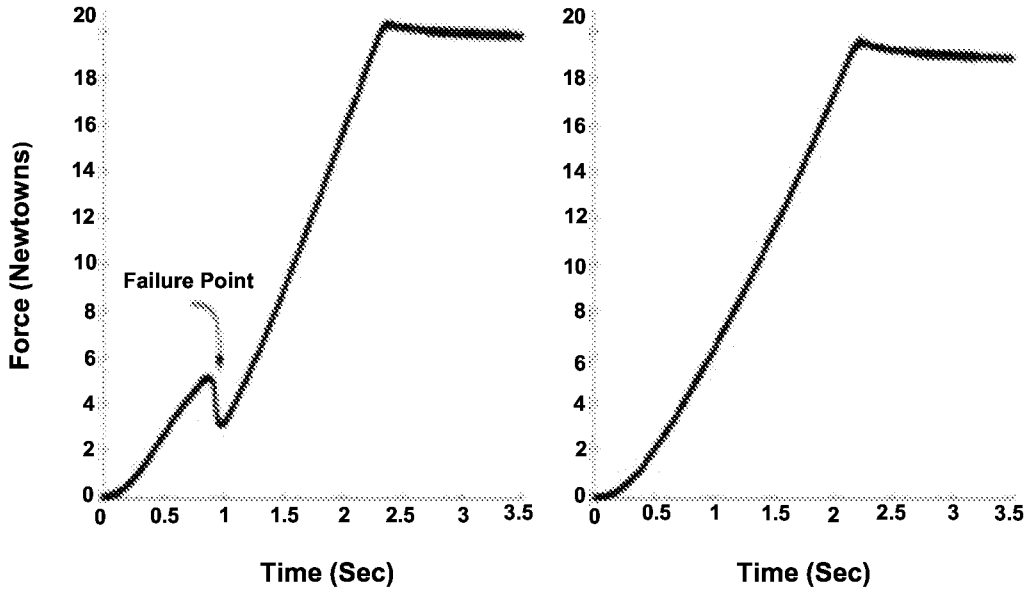

Force (Newtowns)
Failure Point
Time (Sec)
Time (Sec)

FIG. 23

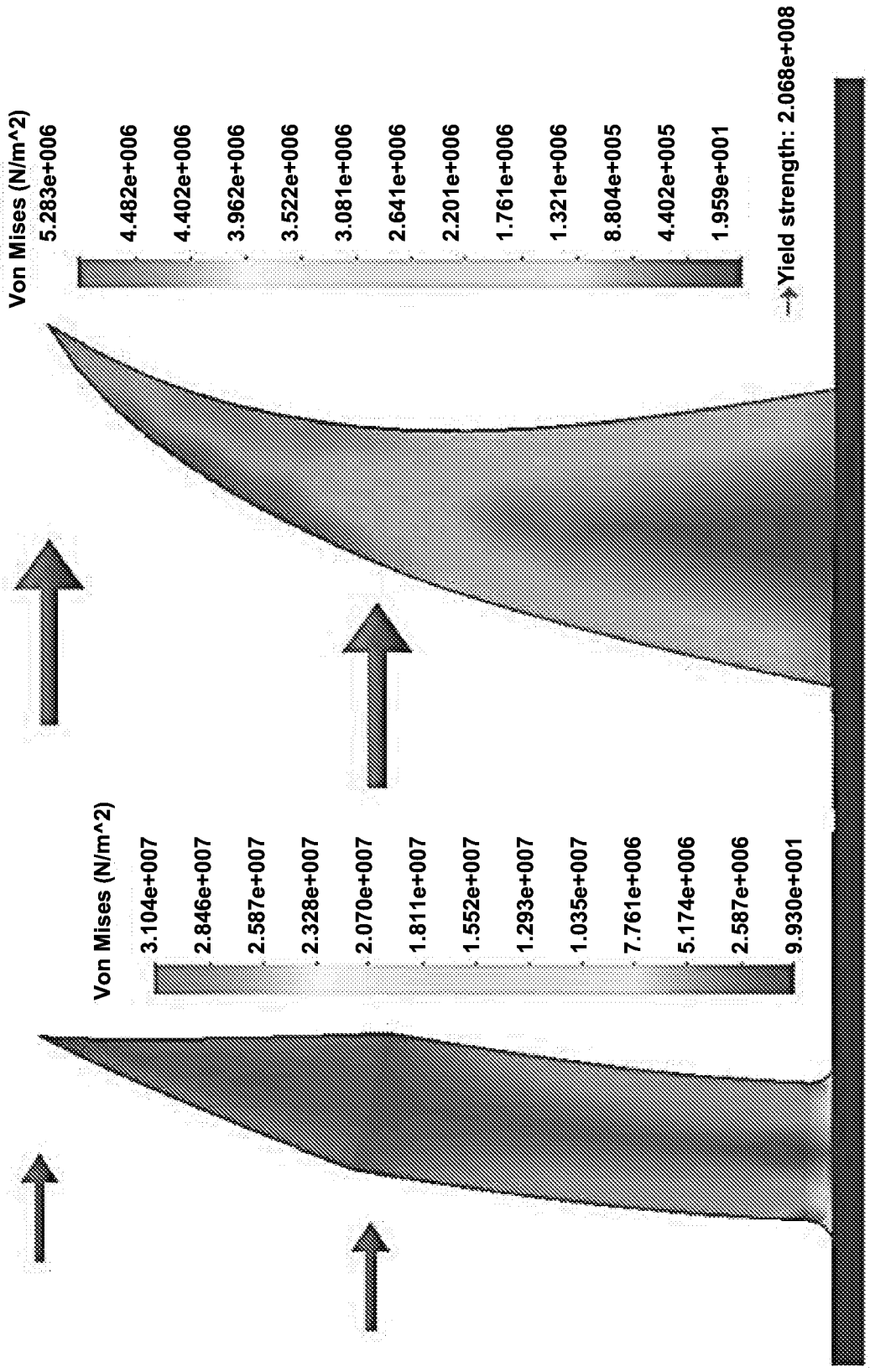

Von Mises (N/m^2)
5.283e+006
4.482e+006
4.402e+006
3.962e+006
3.522e+006
3.081e+006
2.641e+006
2.201e+006
1.761e+006
1.321e+006
8.804e+005
4.402e+005
1.959e+001
Yield strength: 2.068e+008
Von Mises (N/m^2)
3.104e+007
2.846e+007
2.587e+007
2.328e+007
2.070e+007
1.811e+007
1.552e+007
1.293e+007
1.035e+007
7.761e+006
5.174e+006
2.587e+006
9.930e+001

FIG. 24A FIG. 24B

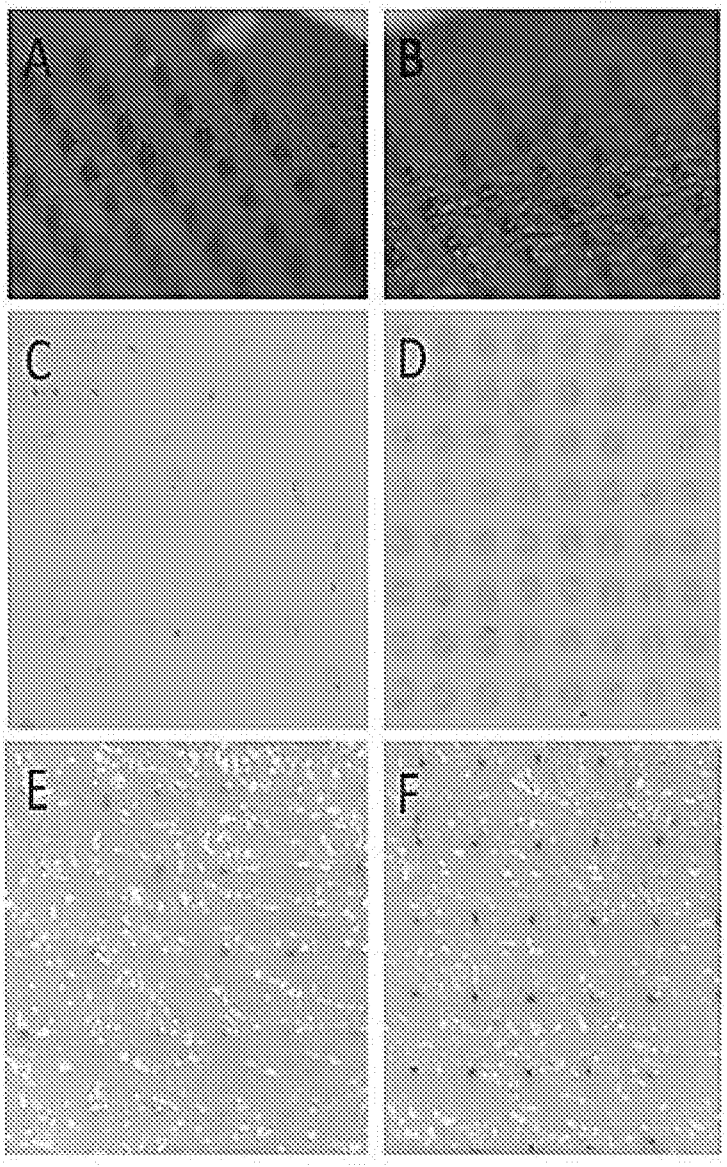


FIG. 24C FIG. 24D

FIG. 24E FIG. 24F

FIG. 25A FIG. 25B FIG. 25C

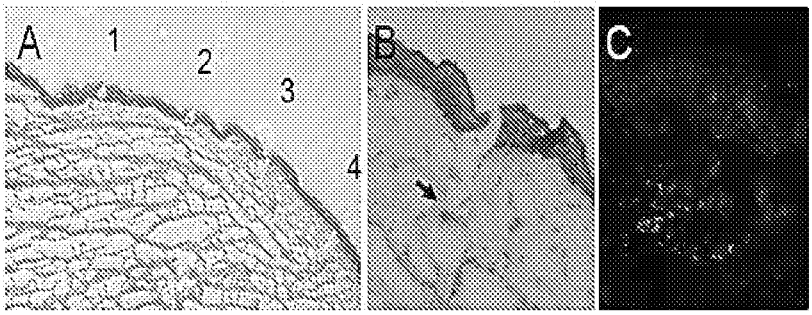


FIG. 26A FIG. 26B

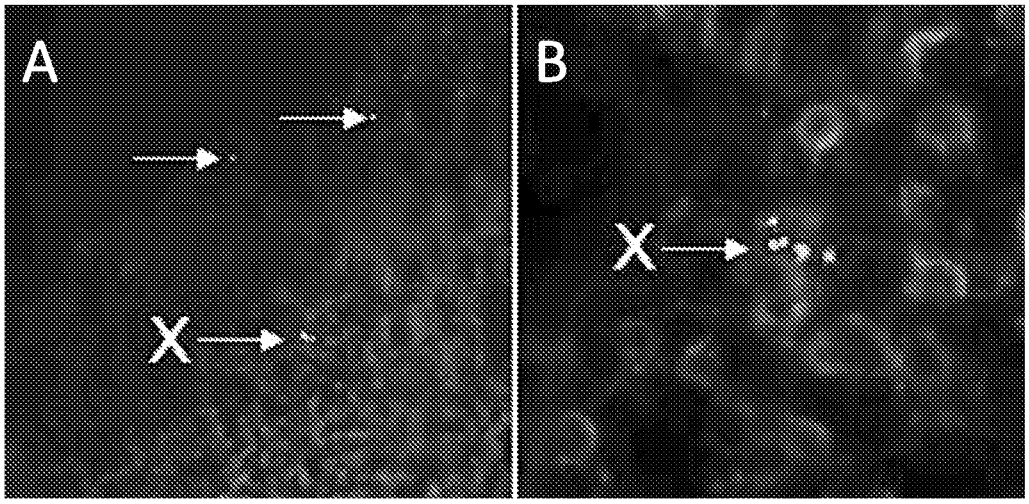


FIG. 27

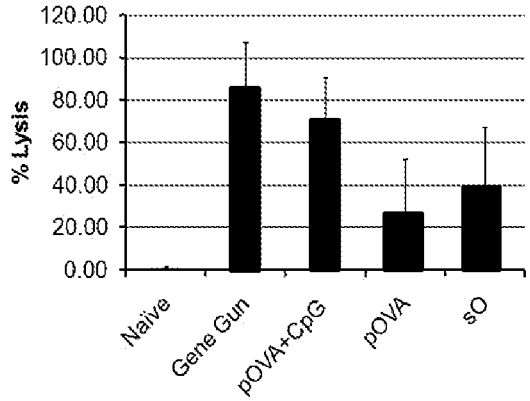


FIG. 28

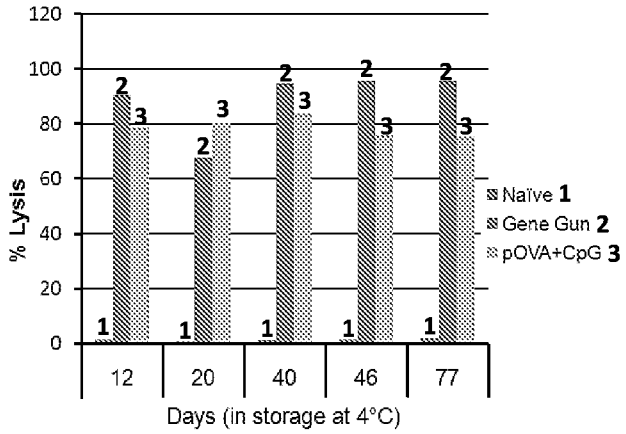


FIG. 29A

FIG. 29B

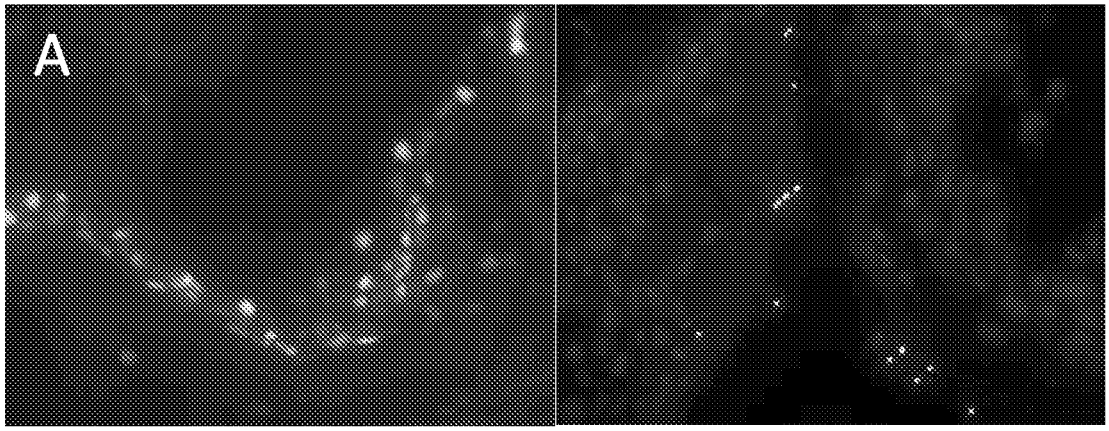


FIG. 30

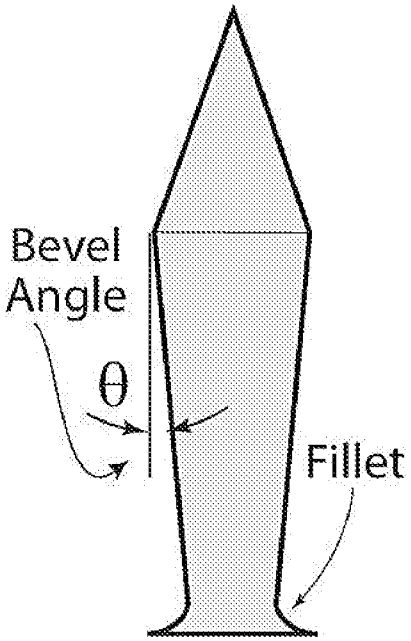


FIG. 31

FIG. 32

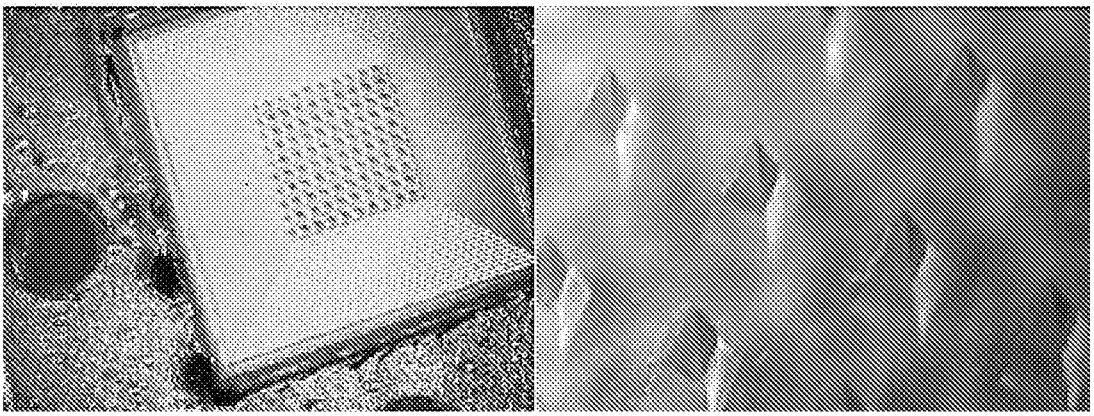


FIG. 33

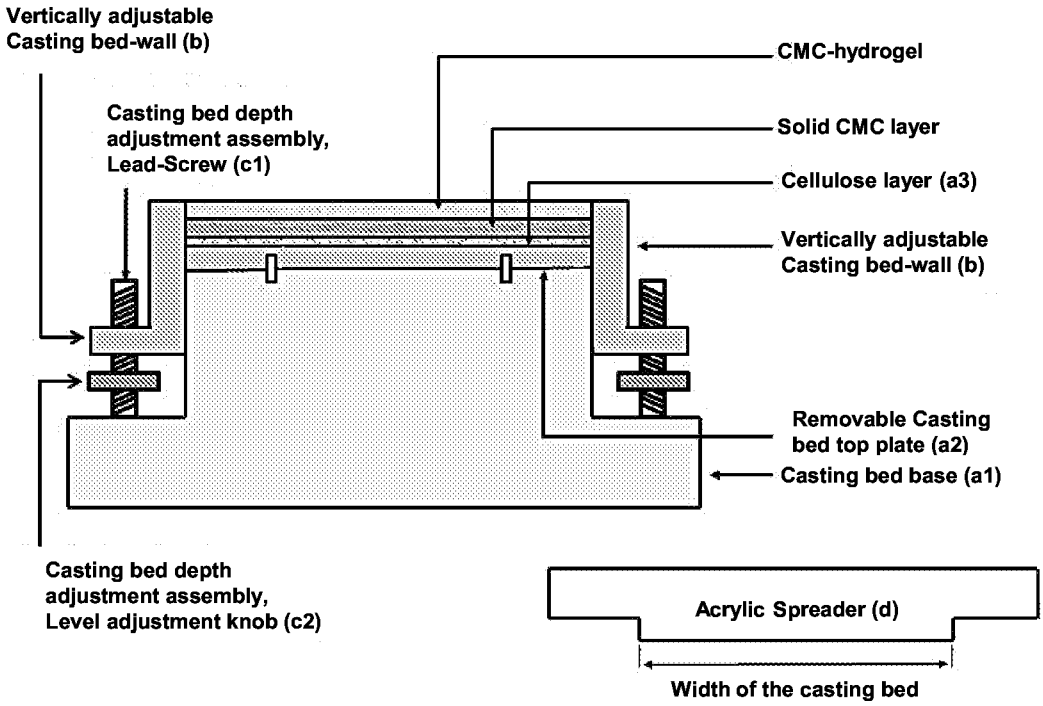

Vertically adjustable
Casting bed-wall (b)
CMC-hydrogel
Casting bed depth
adjustment assembly,
Lead-Screw (c1)
Solid CMC layer
Cellulose layer (a3)
Vertically adjustable
Casting bed-wall (b)
Removable Casting
bed top plate (a2)
Casting bed base (a1)
Casting bed depth
adjustment assembly,
Level adjustment knob (c2)
Acrylic Spreader (d)
Width of the casting bed

FIG. 34

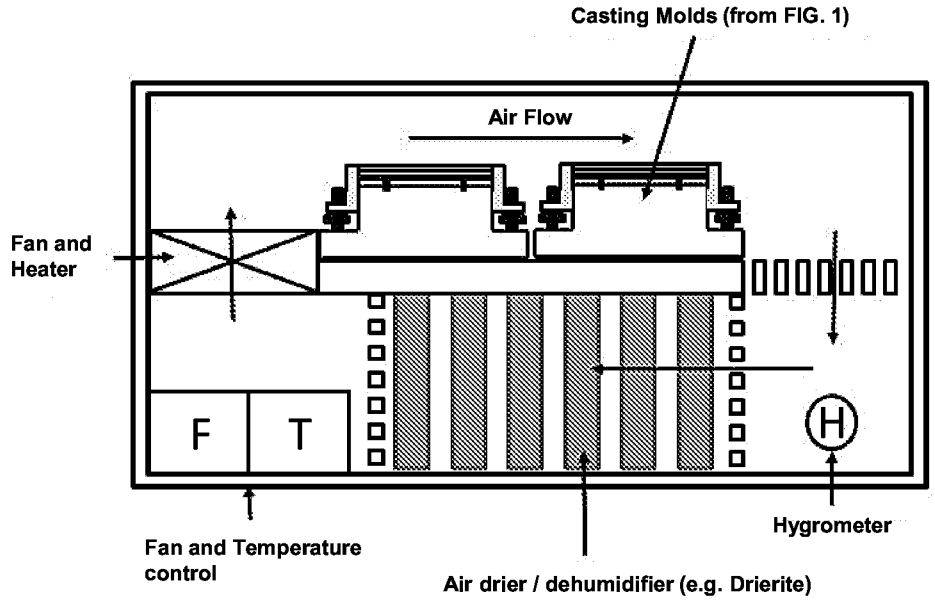

Casting Molds (from FIG. 1)
Air Flow
Fan and
Heater
F
T
H
Fan and Temperature
control
Hygrometer
Air drier / dehumidifier (e.g. Drierite)

FIG. 35

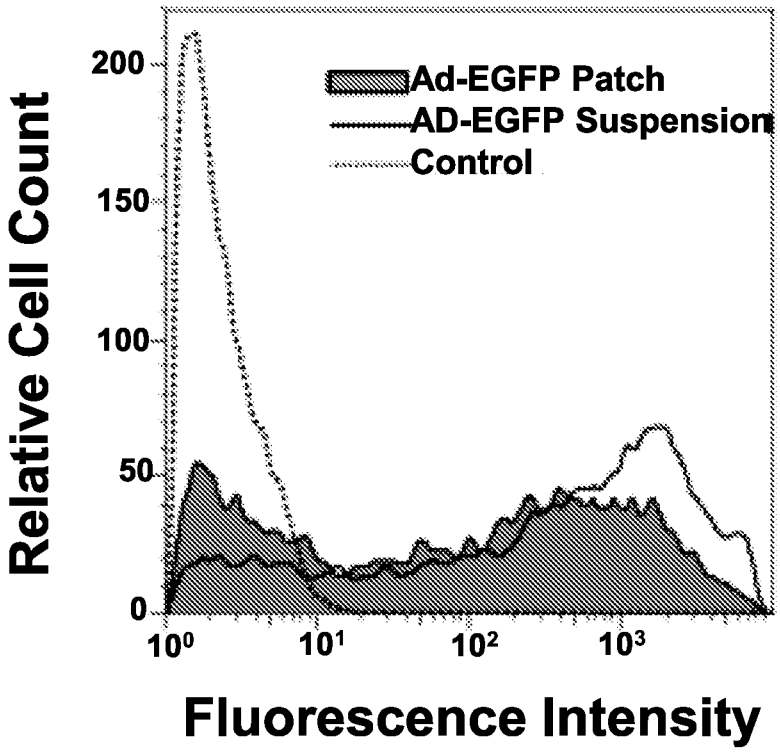

Relative Cell Count
200
150
100
50
0
Ad-EGFP Patch
AD-EGFP Suspension
Control
10^0
10^1
10^2
10^3
Fluorescence Intensity

FIG. 36

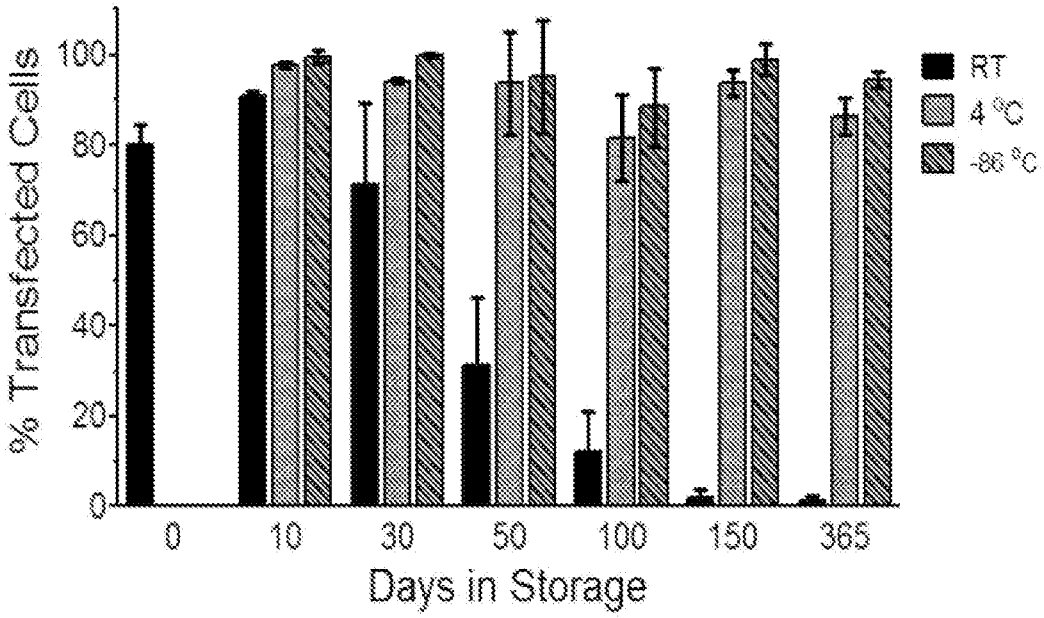

% Transfected Cells
100
80
60
40
20
0
0
10
30
50
100
150
365
Days in Storage
RT
4 °C
-86 °C

FIG. 37

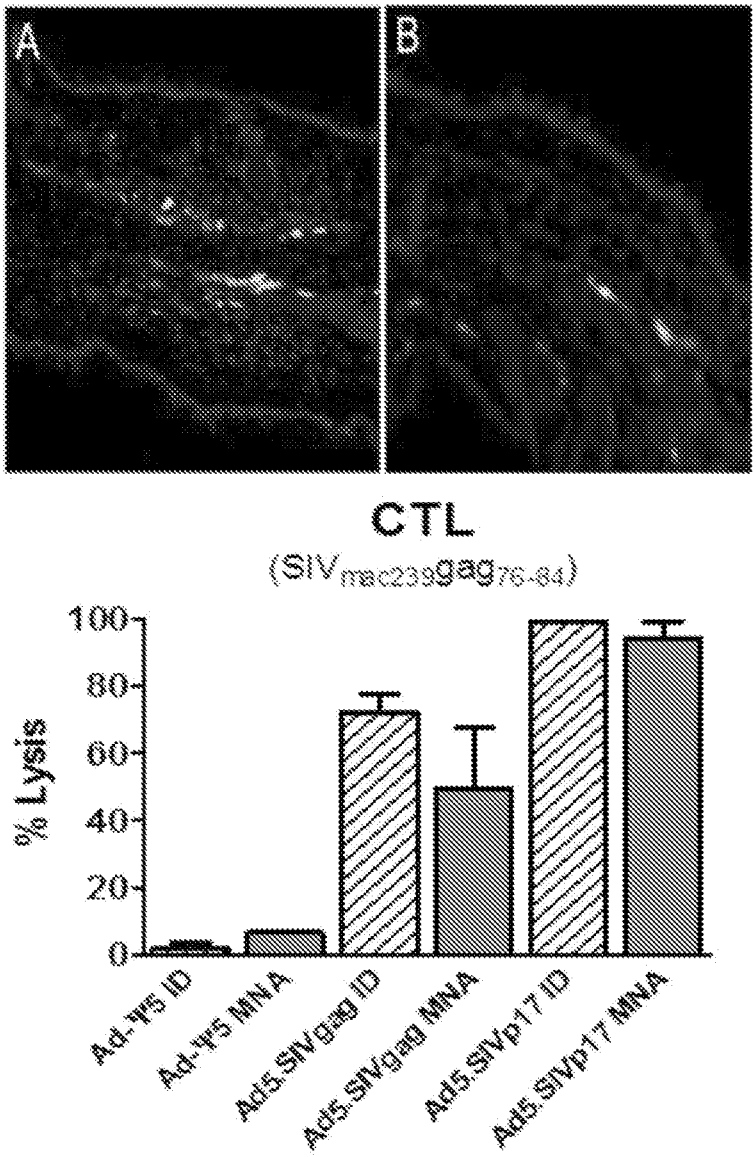

A
B
CTL
(SIVmac239gag76-84)
% Lysis
100
80
60
40
20
0
Ad-HF5 ID
Ad-HF5 MNA
Ad5.SIVgag ID
Ad5.SIVgag MNA
Ad5.SIVp17 ID
Ad5.SIVp17 MNA

FIG. 38

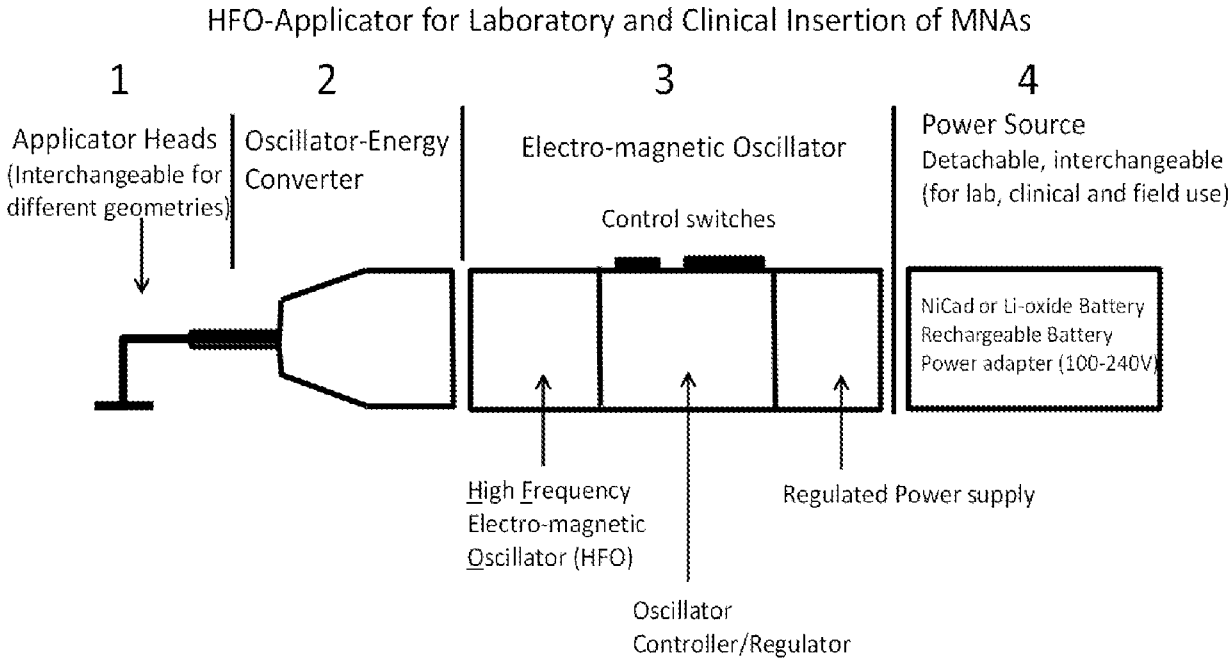

HFO-Applicator for Laboratory and Clinical Insertion of MNAs
1
2
3
4
Applicator Heads
(Interchangeable for different geometries)
Oscillator-Energy Converter
Electro-magnetic Oscillator
Control switches
Power Source
Detachable, interchangeable
(for lab, clinical and field use)
NiCad or Li-oxide Battery
Rechargeable Battery
Power adapter (100-240V)
High Frequency Electro-magnetic Oscillator (HFO)
Regulated Power supply
Oscillator Controller/Regulator

FIG. 39

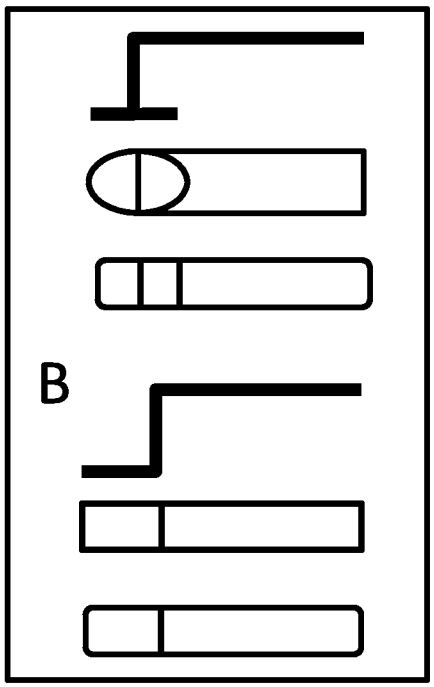

B

FIG. 40

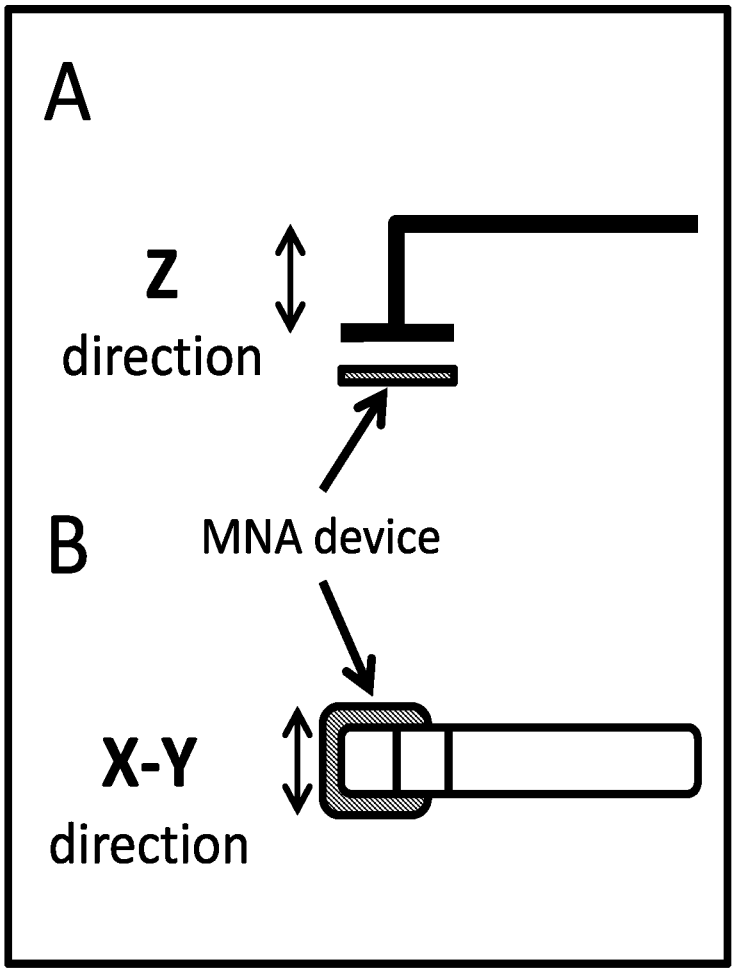


FIG. 41A

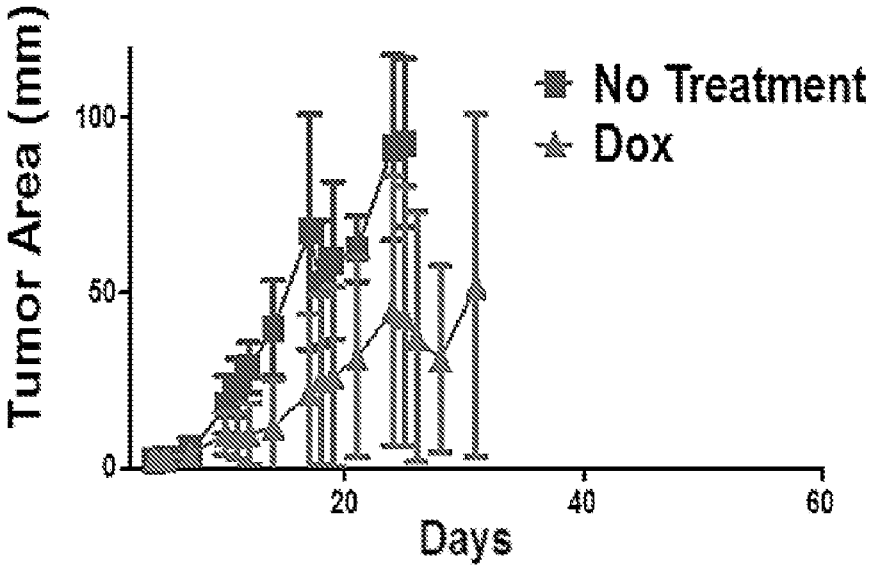


FIG. 41B

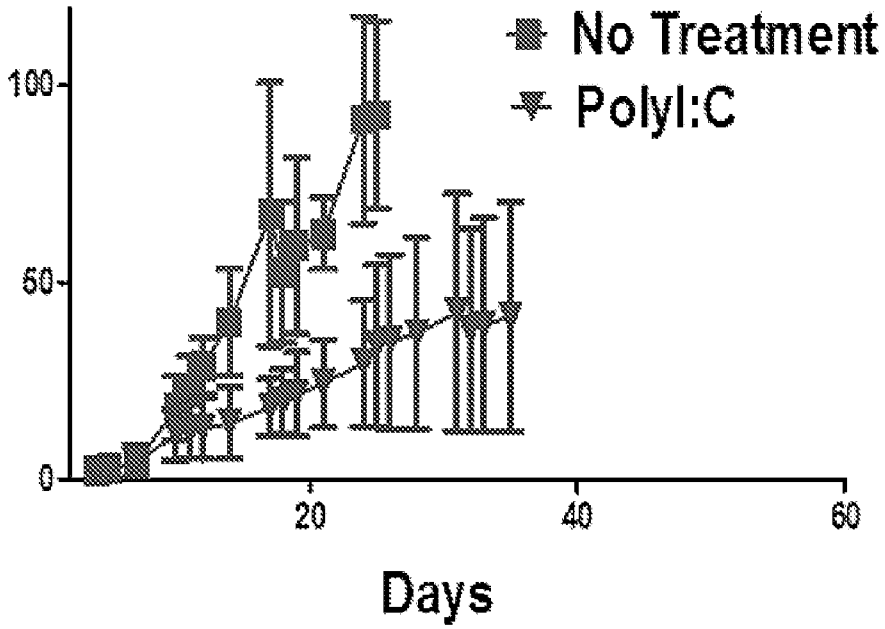


FIG. 41C

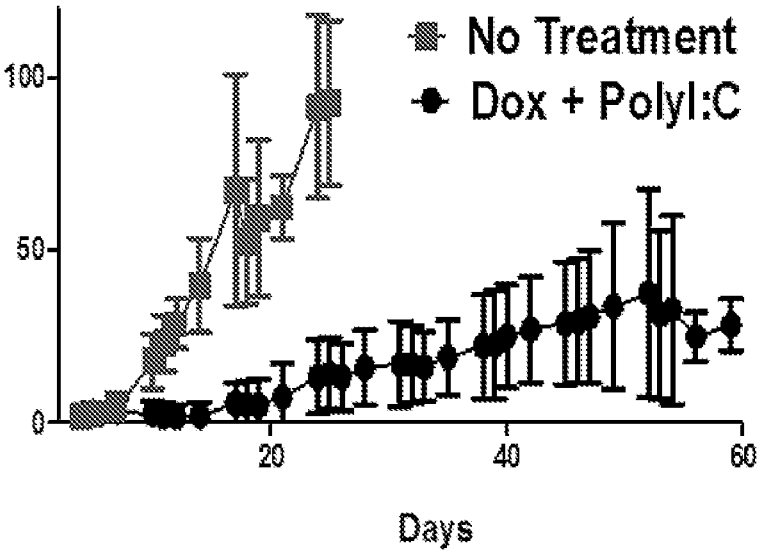


FIG. 41D

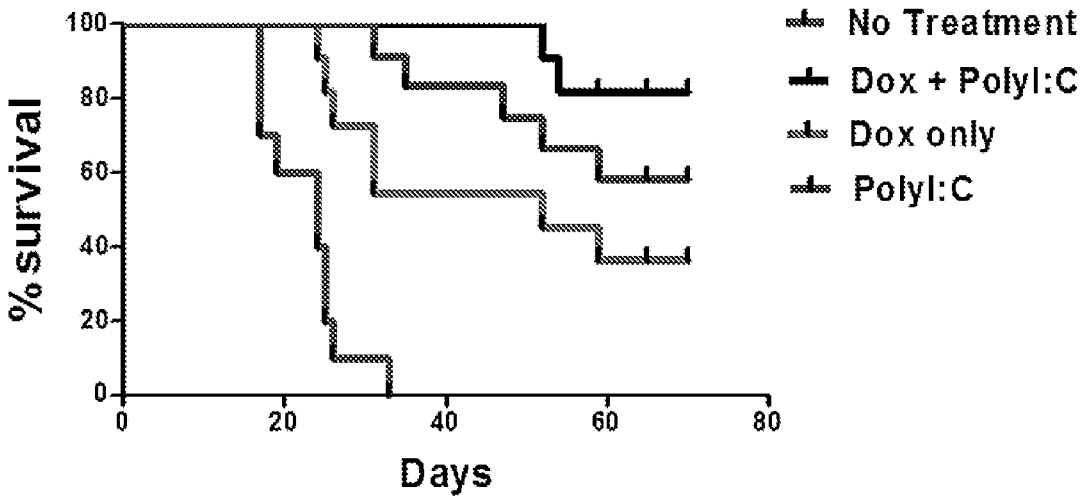


FIG. 42

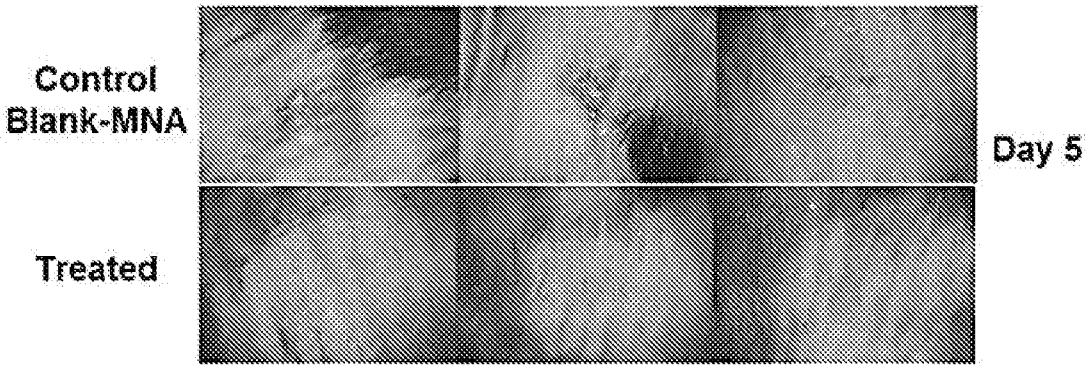

Control
Blank-MNA
Treated
Day 5

FIG. 43

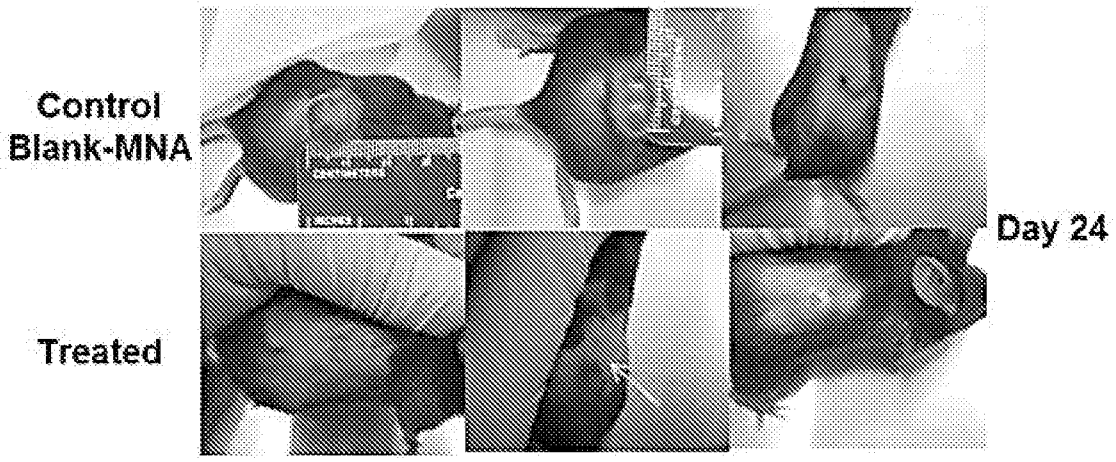

Control
Blank-MNA
Treated
Day 24

FIG. 44

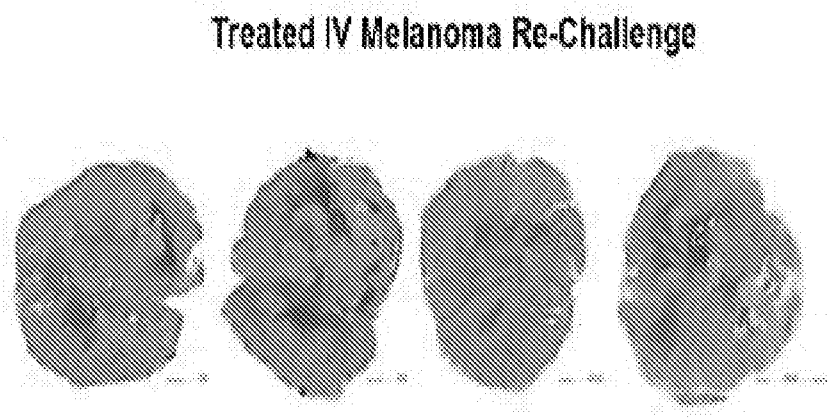


FIG. 45

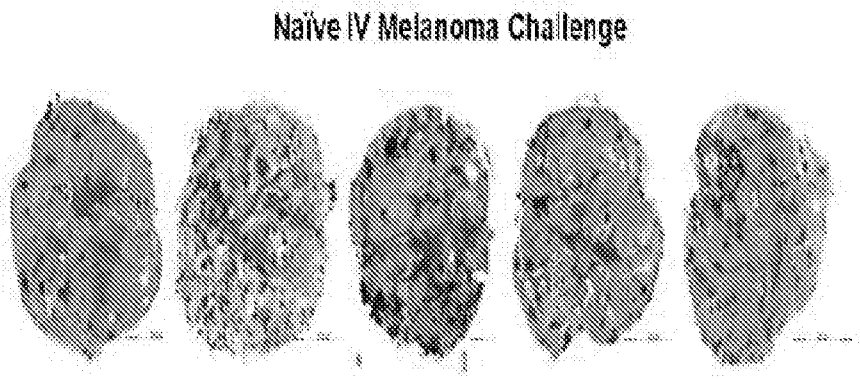


FIG. 46

