FORM 1 THE PATENTS ACT 1970 (39 of 1970) & The Patent Rules, 2003 APPLICATION FOR GRANT OF PATENT (See section 7, 54 & 135, and rule 20(1))	(FOR OFFICE USE ONLY) Application No: Filing Date: Amount of fee paid: CBR No: Signature:

	Application No.	201841030070
	Filing date:	10/08/2018
	Amount of Fee paid:	8800/-
	CBR No:	22354
	Signature	

1. APPLICANT'S REFERENCE / IDENTITY NUMBER. (AS ALLOTED BY OFFICE)	

2. TYPE OF APPLICATION [Please tick (✓) at the appropriate category]

Ordinary (✓)		Convention ()		PCT-NP ()	
Divisional ()	Patent of Addition ()	Divisional ()	Patent of Addition ()	Divisional ()	Patent of Addition ()

3A. APPLICANTS

Name in Full	Nationality	Country of Residence	Address of Applicant
ALVA'S EDUCATION FOUNDATION	Indian	India	ALVA'S INSTITUTE OF ENGINEERING AND TECHNOLOGY SHOBHAVANA CAMPUS, MIJAR, *MOODBIDRI, DAKSHINA KANNADA* -574225, KARNATAKA, INDIA

3B. CATEGORY OF APPLICANT [Please tick (✓) at the appropriate category]

Natural Person (✓)			Others ( )

4. INVENTOR(S) [Please tick (✓) at the appropriate category]

Are all the inventor(s) same as the applicant(s) named above?	Yes ()	No (✓)

If NO furnish the details of the inventors

Name in Full	Nationality	Country of Residence	Address of Applicant
RASHMI K. R	Indian	India	ALVA'S INSTITUTE OF ENGINEERING AND TECHNOLOGY SHOBHAVANA CAMPUS, MIJAR, MOODBIDRI, DAKSHINA KANNADA - 574225, KARNATAKA, INDIA
JAYARAMA A	Indian	India	ALVA'S INSTITUTE OF ENGINEERING AND TECHNOLOGY SHOBHAVANA CAMPUS, MIJAR, MOODBIDRI, DAKSHINA KANNADA - 574225, KARNATAKA, INDIA

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SIDDHARTHA P. DUTTAGUPTA	Indian	India	INDIAN INSTITUTE OF TECNOLOGY BOMBAY, POWAI, MUMBAI - 400076, MAHARASHTRA, INDIA
SHRIGANESH PRABHU	Indian	India	TATA INSTITUTE OF FUNDAMENTAL RESEARCH, MUMBAI - 400005, MAHARASHTRA, INDIA

5. TITLE OF THE INVENTION		
"A PROCESS FOR FABRICATION OF P(VDF-TrFE) PIEZOELECTRIC BEAMS AND CANTILEVERS AS VIBRATION SENSORS AND ENERGY HARVESTERS"		
6. AUTHORISED REGISTERED PATENT AGENT(S)		
	Name	
	Mobile no.	
7. ADDRESS FOR SERVICE OF APPLICANT IN INDIA	Name	ALVA'S EDUCATION FOUNDATION
	Postal Address	ALVA'S INSTITUTE OF ENGINEERING AND TECHNOLOGY SHOBHAVANA CAMPUS, MIJAR, MOODBIDRI, DAKSHINA KANNADA - 574225, KARNATAKA, INDIA
	Telephone No.	-
	Mobile No.	09892818760/ 09920818760
	Fax No.	08258 – 262726
	E-Mail ID	rpinto1942@gmail.com

8. IN CASE OF APPLICATION CLAIMING PRIORITY OF APPLICATION FILLED IN *CONVNETION COUNTRY, PARTICULARS OF CONVNETION APPLICATION*

Country	Application number	Filing date	Name of applicant	Title of invention	IPC (as classified in the convention country)
Not Applicable					

9. IN CASE OF PCT NATIONAL PHASE APPLICATION, PARTICULARS OF INTERNATIONAL APPLICATION FILED UNDER PATENT CO-OPERATIVE TREATY (PCT)

International application number : Not Applicable	International filing date : Not Applicable

10. IN CASE OF DIVISIONAL APPLICATION FILED UNDER SECTION 16, PARTICULARS OF ORIGINAL (FIRST) APPLICATION

Original (first) application number : Not	Date of filing of Original (first)

Applicable	**application : Not Applicable**
11. IN CASE OF PATENT OF ADDITION FILED UNDER SECTION 54, PARTICULARS OF MAIN APPLICANT OR PATENT	
Main application/ Patent Number : Not Applicable	**Date of Filing of main application : Not Applicable**

12.DECLARATION

i)Declaration by the inventors

(In case the applicant is an assignee: the inventors may sign here in below or the applicant may upload the assignment or enclose the assignment with this application for patent or send the assignment by post/electronic transmission duly authenticated within the prescribed period)

We, the above named inventors are the true and first inventors for this invention and declare that the applicants herein are our assignee or legal representative.

(a)Date:23.07.2018

(b)Signature of the inventors:

(c)Names:

Rashmi K. R

Jayarama A

Richard Pinto

Siddhartha P. Duttagupta

Shriganesh Prabhu

ii)Declaration by the applicant:

I, the applicant hereby declare that:-

- ☐ I am in possession of the above mentioned invention.
- ☐ The provisional/complete specification relating to the invention is filed with this application.
- ☐ The invention as disclosed in the specification uses the biological material from India and the necessary permission from the competent authority shall be submitted by us before the grant of the patent to us.
- ☐ There is no lawful ground of objection to the grant of the patent to us.
- ☐ I am the assignee or legal representative of true and first inventors.
- ☐ The application or each of the application, particulars of which are given in Para 5 was the first application in convention country/countries in respect of our invention.
- ☐ I claim the priority from the above mentioned applications filed in convention country and state that no application for protection in respect of the invention had been made in a convention country before that date by me/us or by any person from which we derive the title.
- ☐ My application in India is based on international application under Patent Cooperation Treaty (PCT) as mentioned in Para–9.
- ☐ The application is divided out of our application particulars of which are given in Para-10 and pray that this application may be treated as deemed to have been filed on..... undersection16 of the Act.
- ☐ The said invention is an improvement in or modification of the invention particulars of which are given in Para-11

13. FOLLOWING ARE THE ATTACHMENTS WITH THE APPLICATION

(a) Form 2

Item	Details	Fee	Remarks
Complete/ Provisional Specification #	No. of Pages: 8		
No. of Claims	No. of claims: 1 No. of Pages : 2		
Abstract	No. of Pages : 1		
No. of Drawings	No. of drawings : 6 No. of pages : 14		

In case of a complete specification, if the applicant desires to adopt the drawings filed with his provisional specification as the drawings or part of drawings for the complete specification under rule 13(4), the number of such pages filed with the provisional specification are required to mentioned here.

(b) Complete specification (in confirmation with the international application)/ as amended before the International preliminary Examination Authority (IPEA), as applicable (2 copies).

(c) Sequence listing in electronic format.

(d) Drawing (in confirmation with the international application)/ as amended before the International preliminary Examination Authority (IPEA), as applicable (2 copies).

(e) Priority document (s) or a request to retrieve the priority document(s) from DAS (Digital Access Service) if the applicant had already requested the office of first filing to make the priority document(s) available to DAS.

(f) Translation of priority document/ Specification/ International Search Report/ International Preliminary Report on Patentability.

(g) Statement and Undertaking on Form 3.

(h) Declaration of Inventor ship on Form 5.

(i) Power of Attorney.

(j) Total Fee ₹ -------- in Cheque bearing no: _____ dated this _____ drawn from _____ bank, _____.

We hereby declare that to the best of our knowledge, information, and belief that the fact and matters stated herein are correct and we request that a patent may be granted to us for the said invention Dated this 23rd day of July, 2018.

Signatures

Alva's Education Foundation

Chairman
Alva's Education Foundation (R)
MOODBIDRI - 574227, D.K.

Rashmi K. R

Jayarama A

Richard Pinto

Siddhartha P. Duttagupta

Shriganesh Prabhu

To,
The Controller of Patents,
Patent Office Chennai,
Chennai – 600 032.

FORM 2
THE PATENTACT 1970
(39 of 1970)
&
The Patents Rules, 2003
COMPLETE SPECIFICATION
(See section10 and rule 13)

TITLE OF THE INVENTION

"A PROCESS FOR FABRICATION OF P(VDF-TrFE) PIEZOELECTRIC BEAMS AND CANTILEVERS AS VIBRATION SENSORS AND ENERGY HARVESTERS"

APPLICANT'S NAME AND ADDRESS

ALVA'S EDUCATION FOUNDATION

INDIAN NATIONAL

ADDRESS

ALVA'S INSTITUTE OF ENGINEERING AND TECHNOLOGY, SHOBHAVANA CAMPUS, MIJAR, MOODBIDRI, DAKSHINA KANNADA - 574225, KARNATAKA, INDIA

Dated this the 23rd day of July, 2018

FORM 3
THE PATENTS ACT, 1970
(38 OF 1970)
&
The Patents Rules, 2003
STATEMENT AND UNDERTAKING UNDER SECTION 8
(See section 8 rule 12)

1. Name of the Applicant	We, **ALVA'S EDUCATION FOUNDATION, RASHMI K. R, JAYARAMA A and RICHARD PINTO** addressed at **ALVA'S INSTITUTE OF ENGINEERING AND TECHNOLOGY, SHOBHAVANA CAMPUS, MIJAR, MOODBIDRI, DAKSHINA KANNADA - 574225, KARNATAKA, INDIA, SIDDHARTHA P. DUTTAGUPTA** addressed at **INDIAN INSTITUTE OF TECNOLOGY BOMBAY, POWAI, MUMBAI - 400076, MAHARASHTRA, INDIA** and **SHRIGANESH PRABHU** addressed at **TATA INSTITUTE OF FUNDAMENTAL RESEARCH, MUMBAI - 400005, MAHARASHTRA, INDIA** do hereby declare that we have not made any application for the same/substantially the same invention outside India

2. Name, address and nationality of the joint applicant. - N.A.

Name of the country	Date of application	Application No.	Status of the application	Date of publication	Date of grant
NA	NA	NA	NA	NA	NA

3. Name and address of the assignee	Not Applicable
4. To be signed by the applicant or his authorized registered patent agent.	(a) Date: 23.07.2018 (b) Signature of the inventor:

5. Name of the natural person who has signed	Alva's Education Foundation Chairman Rashmi K. R Jayarama A Richard Pinto Siddhartha P. Duttagupta Shriganesh Prabhu Date: 23.07.2018

To The Controller of Patents, The Patent Office, at Chennai

Applicants:
1. Rashmi K. R
2. Jayarama A
3. Richard Pinto
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5. Shriganesh Prabhu
6. Alva's Education Foundation

ABSTRACT

The process for fabrication of poly (vinylidenefluoride-co-trifluoroethylene) piezoelectric beams and cantilevers comprises cleaning, etching and spinning methods. The present process utilizes silicon wafer as a starting substrate material that is cleaned and oxidized for growth of silicon dioxide, spun with positive photo resist followed by backside patterning to define device regions. The process also uses spinning of positive photo resist for patterning and etching of chrome-gold layer and poly (vinylidenefluoride-co-trifluoroethylene) layer to define cantilevers and beams followed by again spinning of positive photo resist for patterning and etching of chrome-gold layer to define contacts. Further the process utilizes etching of silicon dioxide from the backside of the silicon wafer to release beams and cantilevers. The present invention uses piezoelectric material poly (vinylidenefluoride-co-trifluoroethylene) cantilevers and beams as energy harvesters and vibration sensors.

Dated this 23RD day of JULY, 2018

Signature(s)

Rashmi K. R

Jayarama A

Richard Pinto

Siddhartha P. Duttagupta

Shriganesh Prabhu

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TITLE: A PROCESS FOR FABRICATION OF P(VDF-TrFE) PIEZOELECTRIC BEAMS AND CANTILEVERS AS VIBRATION SENSORS AND ENERGY HARVESTERS

FIELD OF INVENTION

The present invention relates to field of Electromechanics. Specifically, the present invention relates to a process for fabrication of poly (vinylidenefluoride-co-trifluoroethylene) (P (VDF-TrFE) piezoelectric beams and cantilevers as vibration sensors and energy harvesters. Particularly, the present process contains cleaning, etching and spinning. The present process uses piezoelectric material P (VDF-TrFE) as energy harvester and vibration sensor.

BACKGROUND OF THE INVENTION

The idea of vibration detection and power generation using piezoelectric materials is well-known. For low frequency (<1000Hz) vibration detection and energy harvesting, poly (vinylidenefluoride-co-trifluoroethylene) (P (VDF-TrFE)) co-polymers have become important due to their large piezoelectric coefficient and low spring constant. However, fabrication of cantilevers and beams of P (VDF-TrFE) co-polymers has been extremely difficult due to its extreme sensitivity to process chemicals.

The piezoelectric based vibration sensors could be integrated with wireless sensor node for in-vitro applications such as monitoring patient health like heartbeat. Piezoelectric based vibration energy harvesters in the form of beams and cantilevers, have wide ranging potential such as in-vivo applications for powering pacemakers etc. The in-vivo applications however, are challenging due to the bio-compatibility issues of the energy harvester. Nevertheless, the first set of in-vitro applications appear to be realistic.

Vibration monitoring sensors and associated signal conditioning as an integral part of industrial predictive maintenance programs is increasingly becoming important for maintenance and plant engineers for monitoring overall health of the machinery as an effective strategy for reducing downtime. Vibration monitoring sensors are widely used because of their ability to detect and

diagnose a wide variety of machinery faults, such as bearing faults, gear problems, misalignment, mass imbalance, and others, on a wide variety of rotating machinery, and its relative ease of integration with portable data collectors, online vibration monitoring systems, PLC's, and Plant Information (PI) systems.

Various energy harvesters have been devised in prior art some of the measures are as follows:

US20160197261 relates to an energy harvester for converting vibration energy into electrical energy and harvesting the electrical energy, the energy harvester comprising: a base; a clamping structure which is supported by the base and is spaced apart from the base; an elastic member which is disposed between the base and the clamping structure and allows the clamping structure to be elastically moved relative to the base; and a cantilever structure comprising: a cantilever beam having one side which is fixed to the clamping structure and the other side which is elastically bendable; and a mass body which is disposed on the cantilever beam.

US20150203345 relates to a polymer anchored microelectromechanical system (MEMS) cantilever, comprising a base and a cantilever beam projecting from the base, wherein the cantilever beam consists of a piezo layer sandwiched between an inorganic material structural layer and an inorganic material encapsulating and immobilizing layer and a pair of electrical contacts formed in the encapsulating and immobilizing layer in contact with the piezo layer and wherein the base consists of polymer.

A known publication by Ethem Erkan Aktakka et al (2011) in Transducers'11, Beijing, China, June 5-9, 2011, discloses design, fabrication, and testing of a thinned-PZT/Si unimorph cantilever for vibration energy harvesting. This harvester utilizes thinning of bulk-PZT pieces bonded to an SOI wafer, and takes advantage of the similar thermal expansion between PZT and Si to minimize beam bending due to residual stress.

Another known publication by Pierre-Henri Ducrot et al (2016) in Scientific Reports, 2016; 6: 19426 refers a systematic optimization of processing conditions of PVDF-TrFE piezoelectric thin films, used as integrated transducers in organic MEMS resonators. Indeed, despite data on electromechanical properties of PVDF found in the literature, optimized processing conditions

that lead to these properties remain only partially described. In this work, a rigorous optimization of parameters enabling state-of-the-art piezoelectric properties of P (VDF-TrFE) thin films has been performed via the evaluation of the actuation performance of MEMS resonators. Conditions such as annealing duration, poling field and poling duration have been optimized and repeatability of the process has been demonstrated.

Yet another known prior art by Sharon Roslyn Oh et al (2013) in Journal of Micromechanics and Microengineering, Volume 23, Number 9, discuss the fabrication of arrays of piezoelectric P(VDF-TrFE) MEMS cantilevers, batch fabricated via wafer level surface micromachining techniques. In this process Water-soluble poly (vinyl alcohol) (PVA) was selected as the sacrificial layer, due to its compatibility with the processing of P (VDF-TrFE).

Even another known publication by N. Snis et al (2008) in Sensors and Actuators A: Physical, Volume 144, Issue 2, 15 June 2008, Pages 314–320 refers a monolithic multilayer structure of the piezoelectric co-polymer P (VDF-TrFE) by using successive spin coating and electrode evaporation.

The present invention overcomes the inadequacies of the prior art by providing a fabrication process for energy harvester.

OBJECT OF THE PRESENT INVENTION

One or more of the problems of the conventional prior art may be overcome by various embodiments of the present invention.

Accordingly, the primary object of the present invention is to provide a process of fabrication.

It is one object of the present invention, wherein the said process fabricates poly (vinylidenefluoride-co-trifluoroethylene) (P (VDF-TrFE)) piezoelectric beams and cantilevers.

It is another object of the present invention, wherein the said process contains cleaning, etching and spinning methods.

It is even another object of the present invention, wherein the said process contains piranha cleaning and rinsing with isopropyl alcohol, followed by spinning of P (VDF-TrFE).

It is even another object of the present invention, wherein the said P (VDF-TrFE) is a piezoelectric material which is patterned and etched to release free beams and cantilevers as vibration sensors and energy harvesters.

SUMMARY OF THE PRESENT INVENTION

According to the basic aspect of the present invention there is provided a process for fabrication of poly(vinylidenefluoride-co-trifluoroethylene) (P(VDF-TrFE)) piezoelectric beams and cantilevers as vibration sensors and energy harvesters comprising: cleaning of silicon wafers, growing of Silicon dioxide (SiO_2) by wet oxidation, spinning positive photo resist on both sides and backside patterning, etching backside SiO_2 using buffered hydrofluoric acid, stripping front side and back side of positive photo resist using acetone, etching silicon by means of tetra methyl ammonium hydroxide, cleaning of substrate by piranha, rinsing with isopropyl alcohol and pre baking for 15 min at 150°C, spinning the said P(VDF-TrFE), sequential thermal evaporation of Chrome-Gold (Cr-Au), patterning of Cr-Au using, etching Cr-Au using Cr-Au etchant, etching P(VDF-TrFE) by plasma ash using Cr-Au as etch mask, patterning of Cr-Au for contacts, etching Cr-Au using Cr-Au etchant, stripping positive photo resist by UV exposure and developer and etching SiO_2 from backside by plasma etching to free the beams and cantilevers.

It is one aspect of the present invention, wherein the said piranha is cleaned by mixing sulfuric acid and hydrogen peroxide in 3:1 ratio.

It is one aspect of the present invention, wherein the said spinning of P (VDF-TrFE) is done at least at 300 rpm for 10 sec and 1000 rpm for 30 sec and spinning of photo resist is done at least at 3000 rpm for 30 sec.

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2. Jayarama A
3. Richard Pinto
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BRIEF DESCRIPTION OF DRAWINGS

Figure 1 illustrates schematic representation of poly (vinylidenefluoride-co-trifluoroethylene) piezoelectric cantilever, wherein a represents P (VDF-TrFE), b represents Cr-Au IDE, c represents Fixed End, according to present invention.

Figure 2 illustrates schematic representation of poly (vinylidenefluoride-co-trifluoroethylene) piezoelectric beam, wherein a represents P (VDF-TrFE), b represents Cr-Au IDE, c represents Fixed End, according to present invention.

Figure 3 illustrates P (VDF-TrFE) cantilever or beam as vibration sensor, according to present invention.

Figure 4 illustrates poly (vinylidenefluoride-co-trifluoroethylene) cantilever or beam as energy harvester, wherein d represents silicon wafer 2 inch, e represents 2.5 micron thick P(VDF-TrFE), f represents Cr/Au contact, according to present invention.

Figure 5 (a- o) illustrates the diagrammatic representation of process flow of for fabrication of cantilevers and beams, wherein from figure 5 (i - o) 1 represents cantilever and 2 represents beam, according to present invention.

Figure 6 illustrates the flow chart of process flow of for fabrication of cantilevers and beams, according to present invention.

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DETAILED DESCRIPTION OF INVENTION WITH REFERENCE TO ACCOMPANYING DRAWINGS

The preferred embodiment of the present invention will now be explained with reference to the accompanying drawings. It should be understood however that the disclosed embodiments are merely exemplary of the invention, which may be embodied in various forms. The following description and drawings are not to be construed as limiting the invention and numerous specific details are described to provide a thorough understanding of the present invention, as the basis for the claims and as a basis for teaching one skilled in the art how to make and/or use the invention. However in certain instances, well-known or conventional details are not described in order not to unnecessary obscure the present invention in detail.

With reference to figures 1 – 4, the present invention of a process for fabrication of poly(vinylidenefluoride-co-trifluoroethylene) P(VDF-TrFE) piezoelectric cantilevers and beams as vibration sensors and energy harvesters comprises the process of cleaning, etching, spinning of P(VDF-TrFE) and striping positive photo resist to free beams and cantilevers. These cantilevers and beams can be used as vibration sensors and energy harvesters which are shown in the Figures 3 and 4, respectively.

The said process of fabrication is initiated by cleaning of silicon wafer that is 2 inch diameter and single side polished. Silicon dioxide on cleaned Silicon wafer is allowed to grow by wet oxidation method. The said wafers undergo spinning of positive photo resist on both sides of wafer followed by backside patterning to define device regions. The said SiO_2 is etched from backside using buffered hydrofluoric acid, the composition is ammonium fluoride: hydrofluoric acid in 5:1 ratio. The positive photo resist is stripped from front side and backside by using acetone. The said silicon wafer is then etched fully, about 275 microns depth at the device regions from backside by tetra methyl ammonium hydroxide.

In one process of the present invention, the silicon wafer is cleaned by piranha which is a mixture of sulfuric acid and Hydrogen peroxide in 3:1 ratio. The said silicon wafer is rinsed with

Isopropyl Alcohol and pre-baked for 15 minutes at 150°C and followed by spinning 2.5µm thick P (VDF-TrFE) at 300 rpm for 10sec and 1000 rpm for 30sec and post baked at 120°C.

In another process of the present invention, the said process stipulates sequential thermal evaporation of Chrome-Gold (Cr-Au) whereas Cr is 10nm thick and Au is 140nm thick. The said positive photo resist is spun at 1.5µm thick (3000 rpm for 30 sec) and Cr-Au is patterned using cantilever and beam mask. The said Chrome-Gold is etched using Chrome-Gold etchant. The said P (VDF-TrFE) is then etched using plasma asher and simultaneously positive photo resist is stripped.

In yet another process of the present invention, the positive photo resist is spun at 3000 rpm for 30 sec and Cr-Au is patterned using contacts mask. The said Cr-Au is again etched using Cr-Au etchant. Positive photo resist is stripped by UV exposure and developer. Finally SiO_2 is etched from backside by plasma etching to free the beams and cantilevers.

The detailed process flow for fabrication of cantilevers and beams is shown below, which is only illustrative and should not be construed as limitation. With reference to figure 5 (a- o) and figure 6, the said process flow comprises:

1) Cleaning of silicon wafers with following features: 2 inch diameter, Single Side polished (SSP) and resistivity: 4-7 ohm-cm.

2) Growth of silicon dioxide (1 micron) by Wet oxidation.
3) Spin positive photo resist at the rate of 300 rpm for 10 sec, 3000 rpm for 30 sec on both sides of the wafer and backside patterning.

4) Etching Backside SiO_2 using BHF 5:1.

5) Strip front side and backside positive photo resist using acetone.

6) Etch silicon wafer fully from backside by tetra methyl ammonium hydroxide (about 275 microns) followed by piranha cleaning.
7) Rinse with isopropyl alcohol and pre bake for 15 min at 150°C followed by spinning ~2.5µm thick P (VDF-TrFE) (300 rpm for 10sec and 1000 rpm for 30sec).

8) Sequential thermal evaporation of Cr-Au (Cr-10 nm and Au-140 nm).

9) Spin positive photo resist on front side at the rate of 300 rpm for 10 sec, 3000 rpm for 30 sec and pattern Cr-Au using cantilever and beam mask.

10) Etch Cr-Au using Cr-Au etchant.

11) Etch P (VDF-TrFE) by plasma asher simultaneously positive photo resist will be stripped.

12) Spin positive photo resist on front side at the rate of 300 rpm for 10 sec, 3000 rpm for 30 sec and pattern Cr-Au using contacts mask.

13) Etch Cr-Au using Cr-Au etchant.

14) Strip positive photo resist by UV exposure and developer.

15) Etch SiO_2 from backside by plasma etching to free the beams and cantilevers.

Although the invention has been described with reference to specific embodiments, this description is not meant to be construed in a limiting sense. Various modifications of the disclosed embodiments, as well as alternative embodiments, will be apparent to persons skilled in the art. It is therefore, contemplated that the appended claims will cover all modifications that fall within the true scope of the invention.

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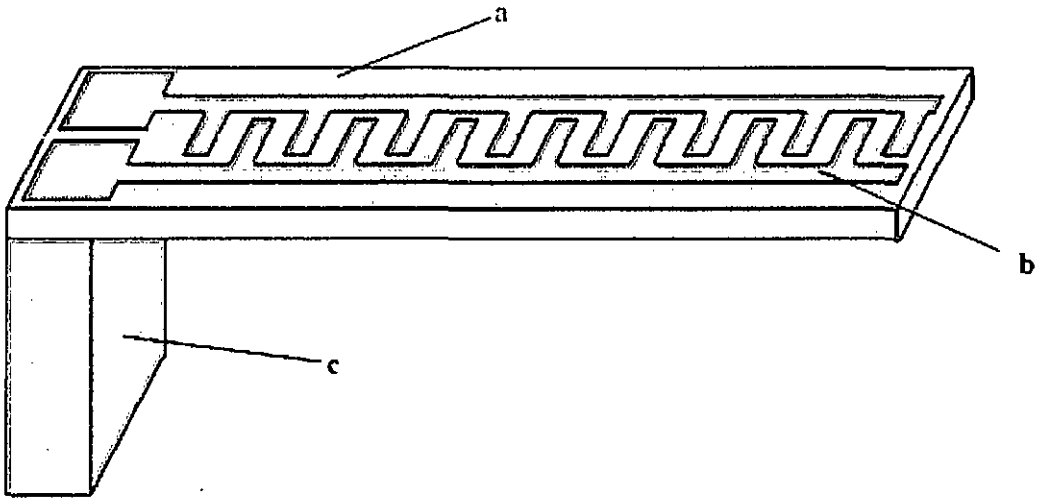
FIGURE 1

Total number of sheets: 14

Number of sheet: 1/14



Dated this 23RD day of JULY, 2018

Signature(s)

Rashmi K. R

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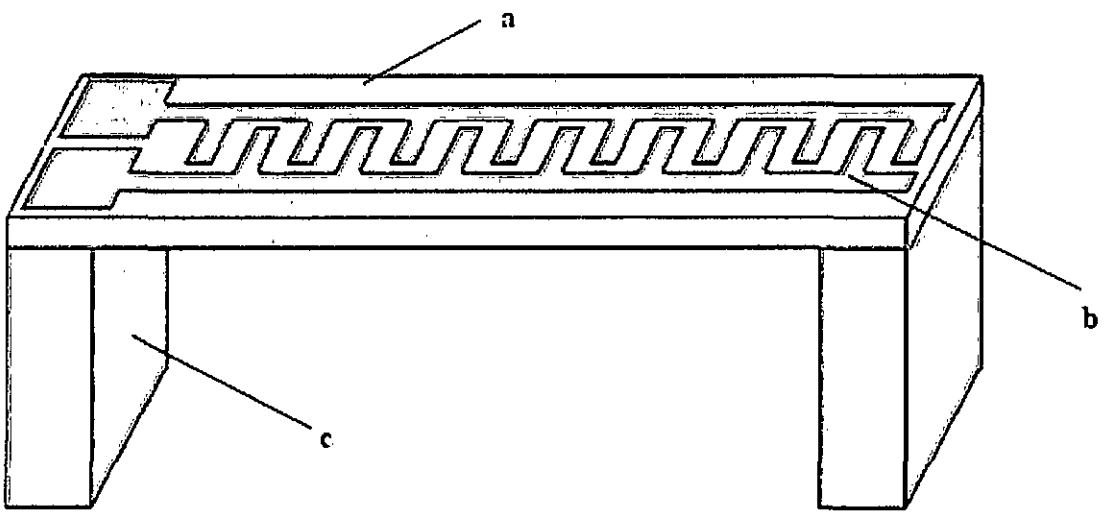
FIGURE 2

Total number of sheets: 14

Number of sheet: 2/14



Dated this 23RD day of JULY, 2018

Signature(s)

Rashmi K. R | Jayarama A | Richard Pinto

Siddhartha P. Duttagupta | Shriganesh Prabhu | Alva's Education Foundation

Chairman

Applicants:
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4. Siddhartha P. Duttagupta
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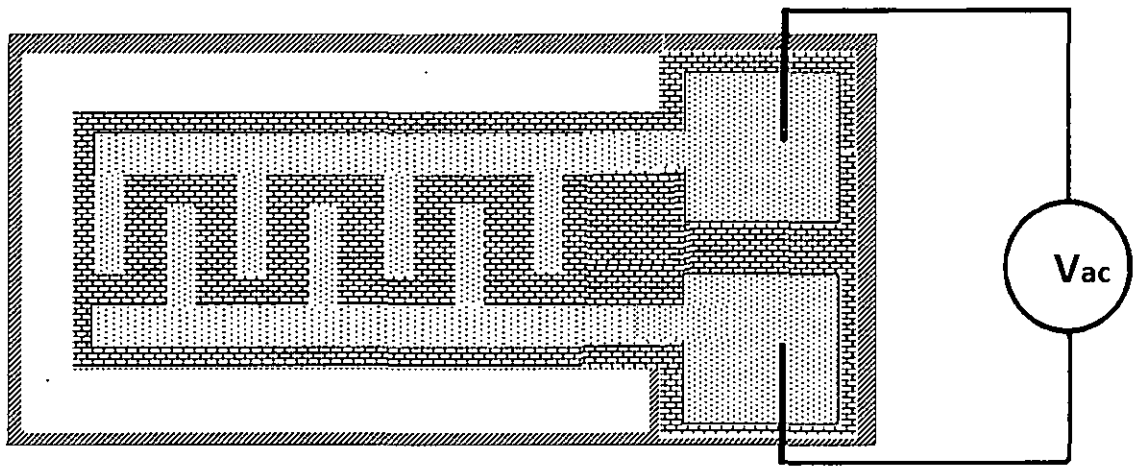
FIGURE 3

Total number of sheets: 14

Number of sheet: 3/14



Dated this 23RD day of JULY, 2018

Signature(s)

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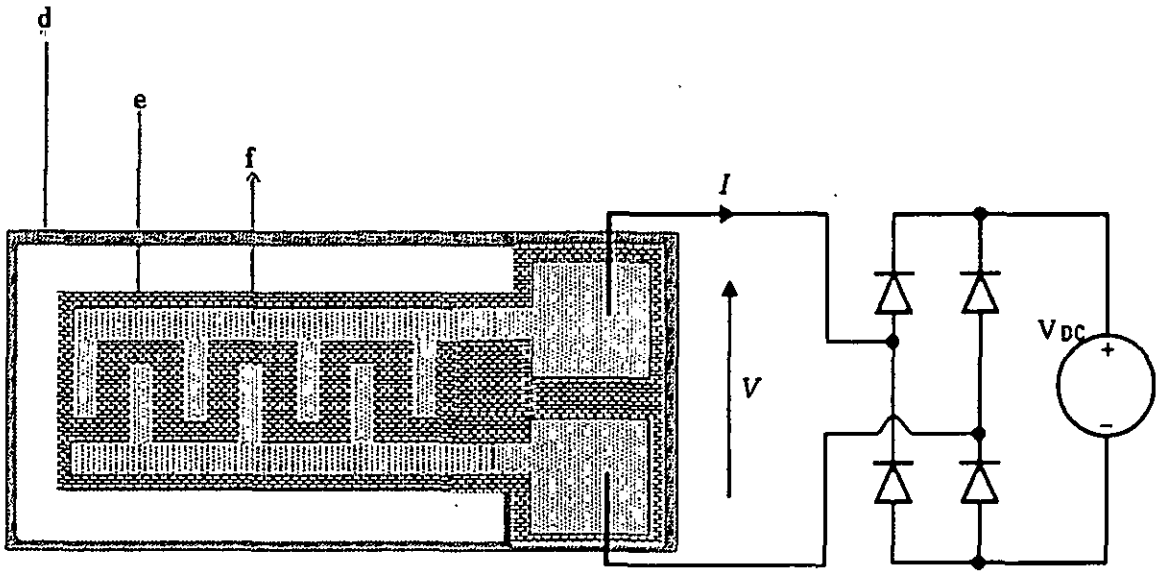
FIGURE 4



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6. Alva's Education Foundation

FIGURE 5 (a)

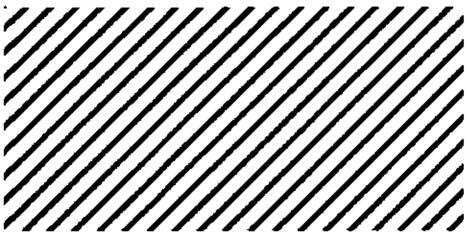
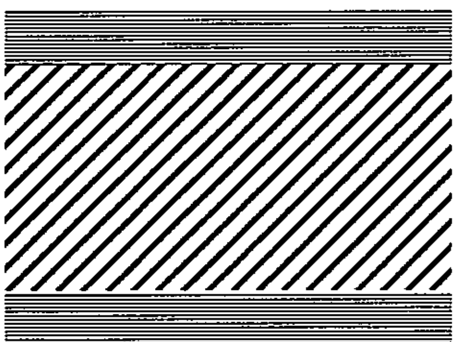


FIGURE 5 (b)



Dated this 23RD day of JULY, 2018

Signature(s)

Rashmi K. R   Jayarama A   Richard Pinto

Siddhartha P. Duttagupta   Shriganesh Prabhu   Alva's Education Foundation

Applicants:
1. Rashmi K. R
2. Jayarama A
3. Richard Pinto
4. Siddhartha P. Duttagupta
5. Shriganesh Prabhu
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FIGURE 5 (c)

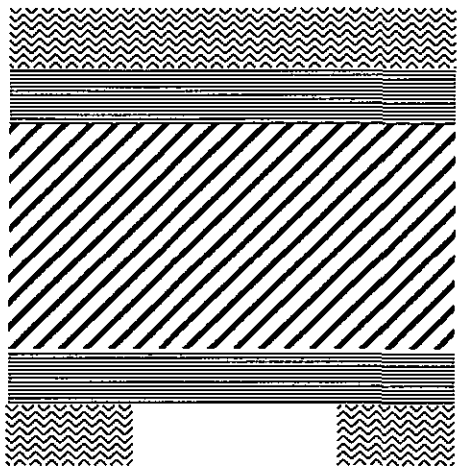
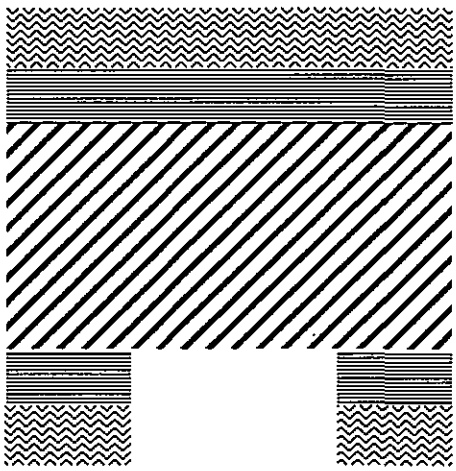


FIGURE 5 (d)



Dated this 23RD day of JULY, 2018

Signature(s)

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Siddhartha P. Duttagupta | Shriganesh Prabhu | Alva's Education Foundation

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FIGURE 5 (g)

Total numbers of sheets: 14

Number of sheet: 8/14

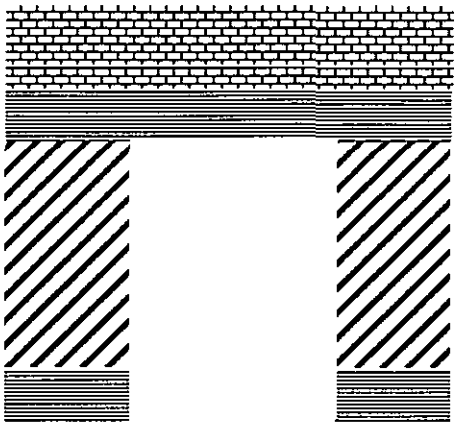
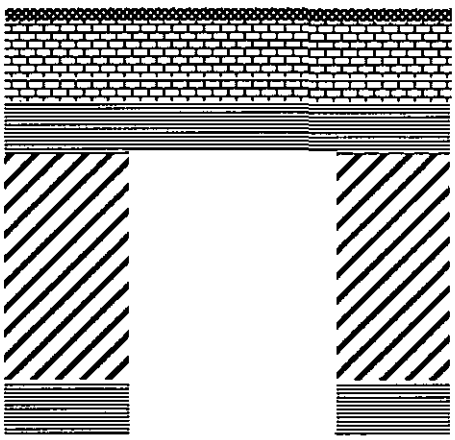


FIGURE 5 (h)



Dated this 23RD day of JULY, 2018

Signature(s)

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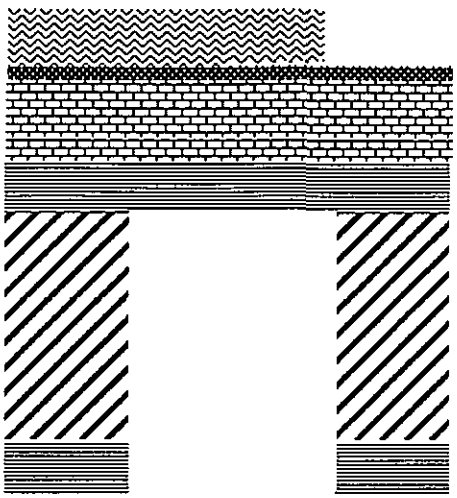
FIGURE 5 (i)

Total number of sheets: 14

Number of sheet: 9/14

1.



2.

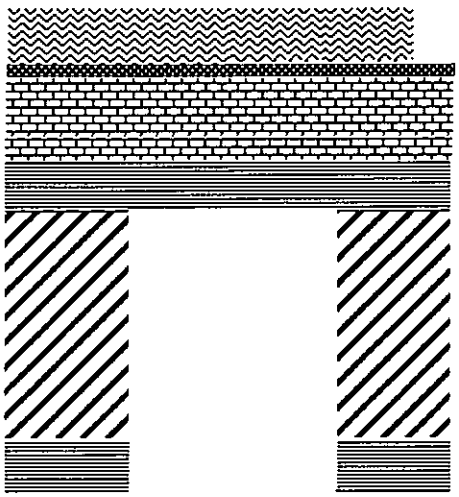
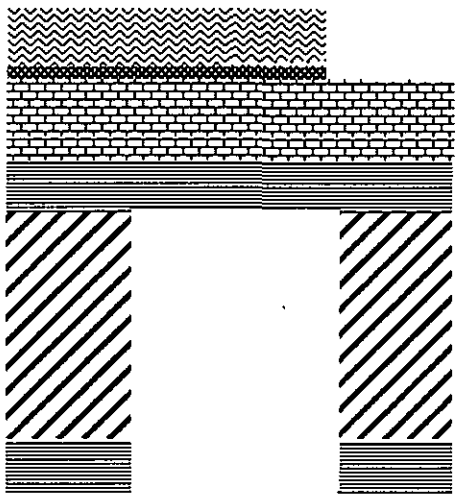


FIGURE 5 (j)

1.



2.

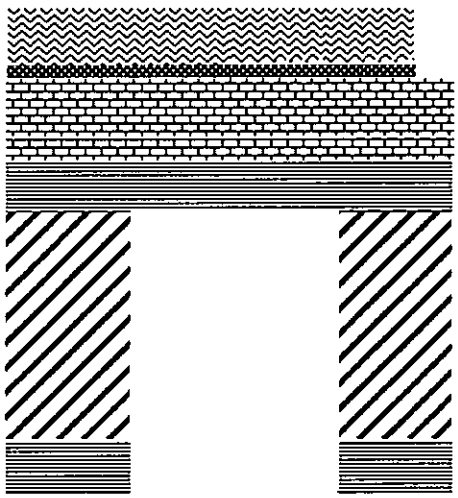


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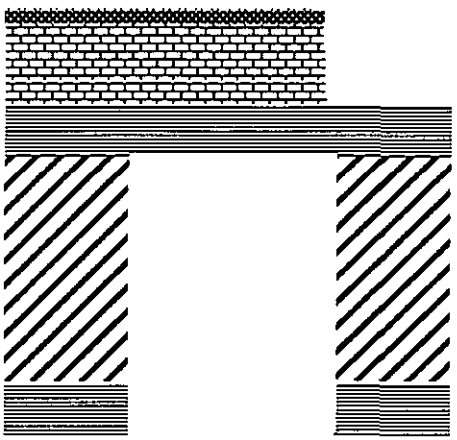
FIGURE 5 (k)

Total numbers of sheets: 14

Number of sheet: 10/14

1.



2.

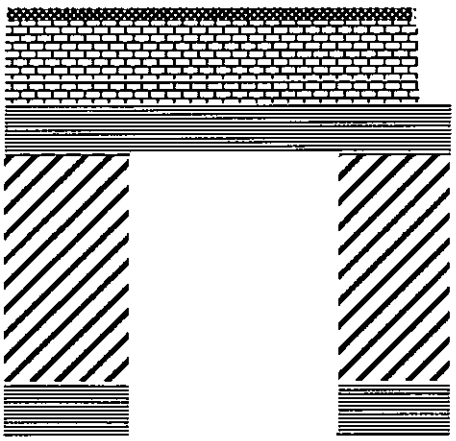
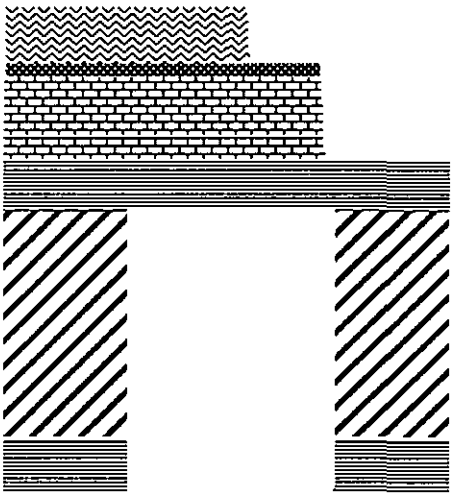


FIGURE 5 (l)

1.



2.

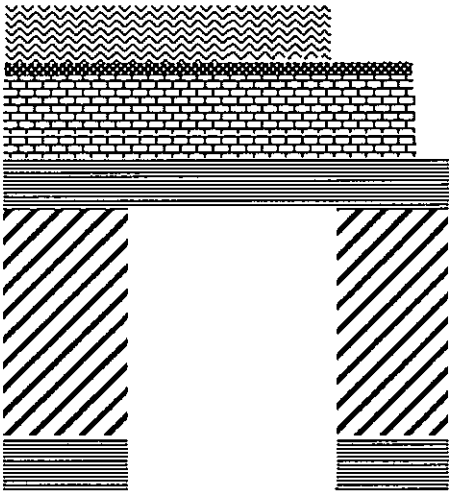


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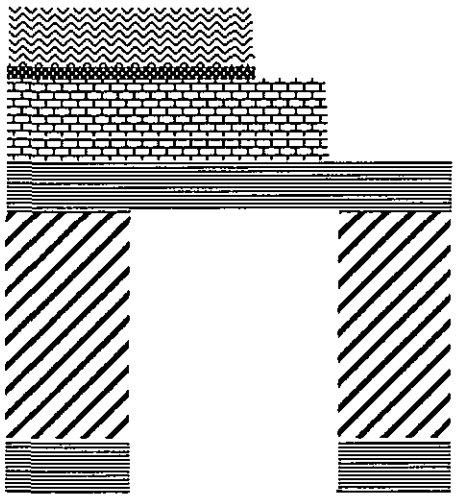
FIGURE 5 (m)

Total number of sheets: 14

Number of sheet: 11/14

1.



2.

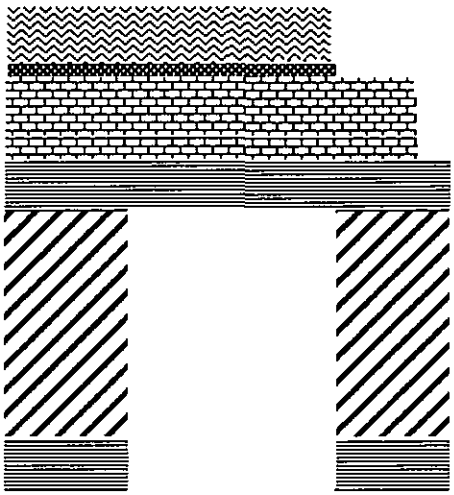
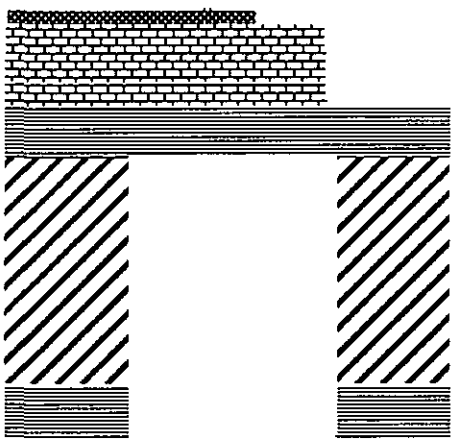
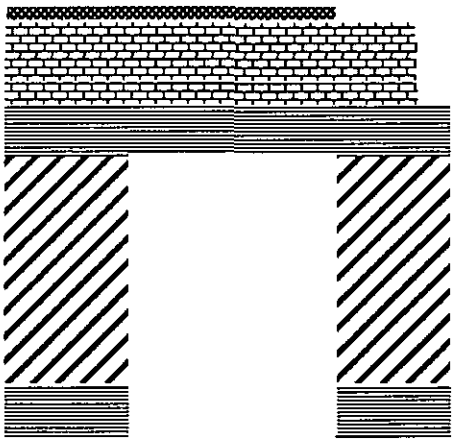


FIGURE 5 (n)

1.



2.



Dated this 23RD day of JULY, 2018

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PATENT OFFICE CHENNAI 23/07/2018 14:44

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5. Shriganesh Prabhu
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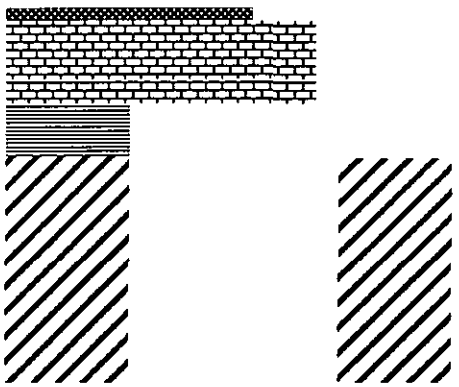
FIGURE 5 (o)

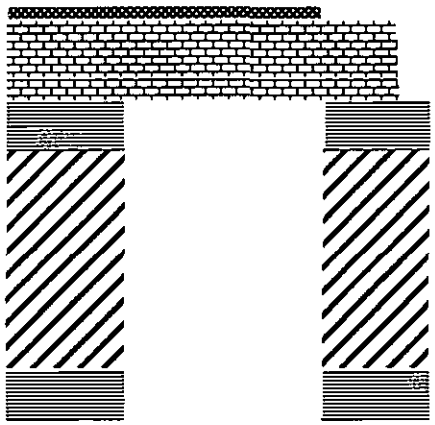
Total number of sheets: 14

Number of sheet: 12/14

1.



2.



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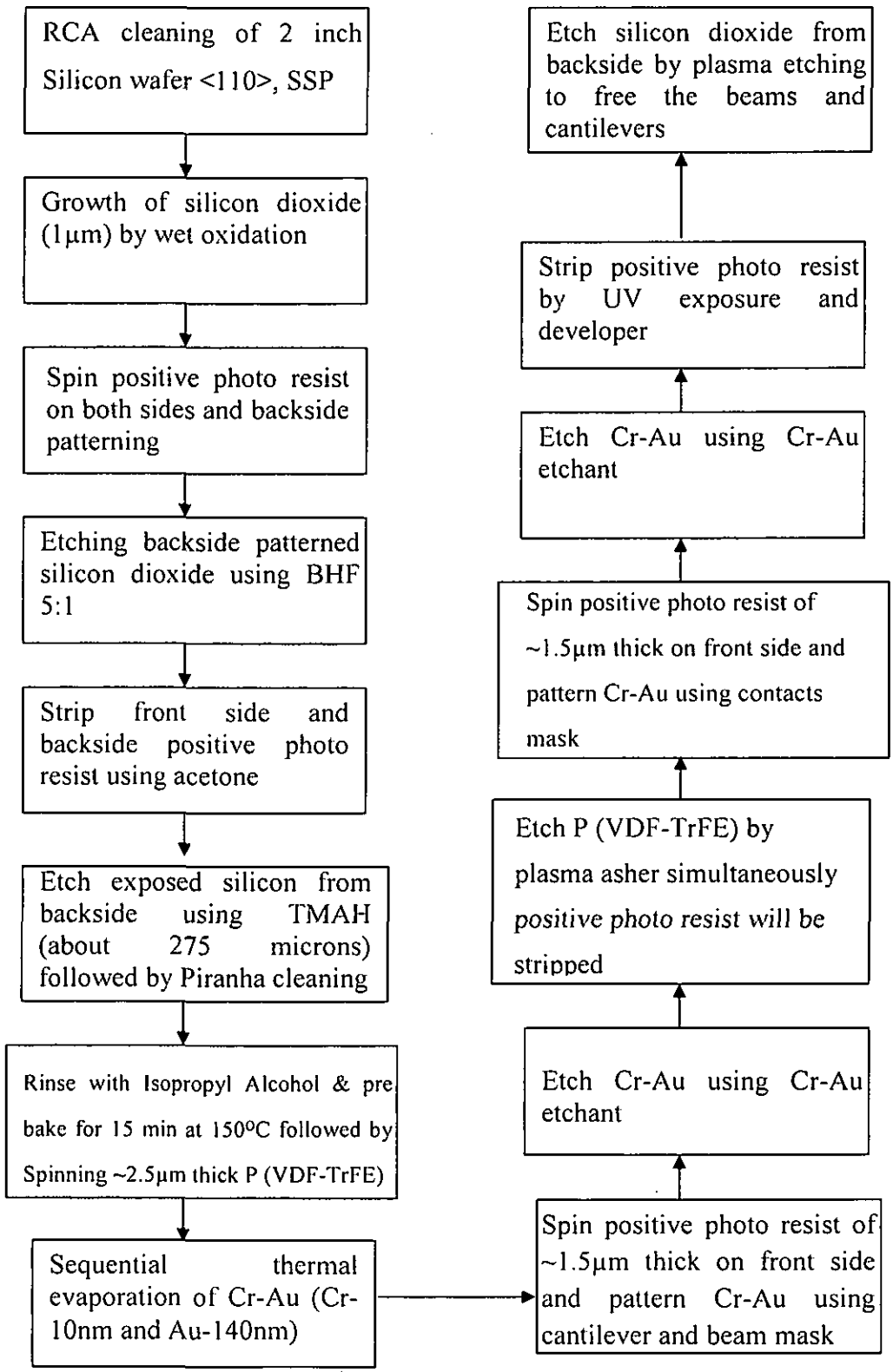
5. Shriganesh Prabhu
6. Alva's Education Foundation

Figure 6



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2. Jayarama A
3. Richard Pinto
4. Siddhartha P. Duttagupta
5. Shriganesh Prabhu
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Total number of sheets: 14

Number of sheet: 14/14

Dated this 23RD day of JULY, 2018

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5. Shriganesh Prabhu
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WE CLAIM

1. A process for fabrication of poly(vinylidenefluoride-co-trifluoroethylene) piezoelectric beams and cantilevers as vibration sensors and energy harvesters comprising:

   a. Cleaning of Silicon wafers;

   b. Growing of SiO_2 by wet oxidation;

   c. Spinning positive photo resist on both sides and backside patterning;

   d. Etching backside patterned SiO_2 using buffered hydrofluoric acid;

   e. Stripping front side and back side of positive photo resist using acetone;

   f. Etching silicon by means of Tetra Methyl Ammonium Hydroxide;

   g. Piranha cleaning;

   h. Rinsing with isopropyl alcohol and pre baking for 15 min at 150°C;

   i. Spinning the said poly (vinylidenefluoride-co-trifluoroethylene);

   j. Deposition of Cr-Au by sequential thermal evaporation;

   k. Spinning of positive photo resist on front side;

   l. Patterning Cr-Au using cantilever and beam mask;

   m. Etching Cr-Au using Cr-Au etchant;

n. Etching poly (vinylidenefluoride-co-trifluoroethylene) using plasma asher;

o. Spinning of positive photo resist on front side;

p. Patterning Cr-Au using contacts mask;

q. Etching Cr-Au using Cr-Au etchant;

r. Stripping positive photo resist by UV exposure and developer; and

s. Etching backside SiO_2 by plasma etching to free the beams and cantilevers.

2. The process as claimed in claim 1, wherein the said piranha cleaning is done by mixing sulfuric acid and hydrogen peroxide in 3:1 ratio.

3. The process as claimed in claim 1, wherein the said spinning of poly (vinylidenefluoride-co-trifluoroethylene) is done at least at 300 rpm for 10 sec and 1000 rpm for 30 sec and spinning of positive photo resist is done at least at 3000 rpm for 30 sec.

Dated this 23RD day of JULY, 2018

Signature(s)

Rashmi K. R

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FORM 5
THE PATENTS ACT, 1970
(38 OF 1970)
&
The Patents Rules, 2003
STATEMENT AND UNDERTAKING UNDER SECTION 8
(See section 8 rule 12)

We, **ALVA'S EDUCATION FOUNDATION, RASHMI K. R, JAYARAMA A and RICHARD PINTO** addressed at **ALVA'S INSTITUTE OF ENGINEERING AND TECHNOLOGY, SHOBHAVANA CAMPUS, MIJAR, MOODBIDRI, DAKSHINA KANNADA - 574225, KARNATAKA, INDIA, SIDDHARTHA P. DUTTAGUPTA** addressed at **INDIAN INSTITUTE OF TECNOLOGY BOMBAY, POWAI, MUMBAI - 400076, MAHARASHTRA, INDIA** and **SHRIGANESH PRABHU** addressed at **TATA INSTITUTE OF FUNDAMENTAL RESEARCH, MUMBAI - 400005, MAHARASHTRA, INDIA** do hereby declare that to the best of our knowledge, information and belief that the fact and matters stated herein are correct and we request that a patent may be granted to us for the said invention.

Dated this the 23rd day of July, 2018

Signatures

Alva's Education Foundation

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Alva's Education Foundation (R)
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Rashmi K. R

Jayarama A

Richard Pinto

Siddhartha P. Duttagupta

Shriganesh Prabhu

CBR: 35519
DATE: 11/12/2018
Ack: 13750/-

11/12/18

700243972

FORM 9

THE PATENTS ACT, 1970
(39 of 1970)

REQUEST FOR EARLY PUBLICATION
[See section 11A(2); rule 24A]

We, **ALVA'S EDUCATION FOUNDATION,** addressed at **ALVA'S INSTITUTE OF ENGINEERING AND TECHNOLOGY SHOBHAVANA CAMPUS, MIJAR, MOODBIDRI, DAKSHINA KANNADA - 574225, KARNATAKA, INDIA** hereby request for early publication of my Patent application No **201841030070** dated **10.08.2018** for the invention **A PROCESS FOR FABRICATION OF P[VDF-TrFE] PIEZOELECTRIC BEAMS AND CANTILEVERS AS VIBRATION SENSORS AND ENERGY HARVESTERS** under section 11A(2) of the Act.

Dated this the 11th day of December 2018

For **ALVA'S EDUCATION FOUNDATION,**

Authorized Signatory:

Name in full: Mohan Alva

Designation: Chairman.

Seal: Chairman
Alva's Education Foundation (R)
MOODBIDRI - 574227, D.K.

PATENT OFFICE CHENNAI 11/12/2018 14:27

Fee (2) Cash 27500/- Rs13750/-

December 11, 2018

From

RICHARD PINTO,
Alva's Education Foundation,
Alva's Institute Of Engineering And Technology
Shobhavana Campus, Mijar, Moodbidri,
Dakshina Kannada - 574225, Karnataka, India
Email: ariv@leintelligensia.com

D/89435

To

The Controller of Patents,
The Patents Office,
Guindy,
Chennai – 600032.

Sir,

Ref Request for earlier publication of patent applications-reg

*****

We write with reference to the following patent applications.

1. Patent application No **201841030070** dated **10.08.2018** for the invention "A PROCESS FOR FABRICATION OF P[VDF-TrFE] PIEZOELECTRIC BEAMS AND CANTILEVERS AS VIBRATION SENSORS AND ENERGY HARVESTERS" under the name **ALVA'S EDUCATION FOUNDATION**
2. Patent application No **201841040380** dated **26.10.2018** for the invention "ENHANCEMENT OF MICRO DIRECT METHANOL FUEL CELL (μ-DMFC) PERFORMANCE USING MICRO CHANNELS FABRICATED FROM <100> SILICON WAFER ORIENTATION AND P(VDF-TrFE) COATED NAFION MEMBRANE AS PROTON EXCHANGE MEMBRANE" under the name **ALVA'S EDUCATION FOUNDATION**

We submit a request for early publication (Form 9) for each of the above patent applications with sum of Fee Rs.27500/- (Rupees Twenty Seven Thousand and Five Hundred Only). We request you to take the above on record.

Thanking You,

Yours faithfully,

RICHARD PINTO.

Encl As above.

Rs 8800/-

Exp 16
New Appln
10/8/18

10TH AUGUST 2018

From,

M/S.ALVA'S EDUCATION FOUNDATION,
SHOBHAVANA CAMPUS, MIJAR, MOODBIDRI,
DAKSHINA KANNADA - 574225
KARNATAKA, INDIA

(D) 58122

700164395

To

The Controller of Patents,
Patents Office,
Guindy,
Chennai – 600032.

Sir,

Sub: Application for filing Patent Rights-Reg.– Complete Specification.

*****

Referring to the above, we are enclosing **application for request for Complete Specification** along with fee Rs.8800/- (Eight Thousand eight Hundred only) by cash.

The Title of the Patent is as follows:

1. A PROCESS FOR FABRICATION OF PIEZOELECTRIC BEAMS AND CANTILEVERS AS VIBRATION SENSORS AND ENERGY HARVESTERS.

Kindly Acknowledge the same.

Thanking You,

Yours faithfully

R Pinto

RICHARD PINTO(INVENTOR)

Encl:

1. Patent Applications Form – 1,3,5 & 2, Abstract, Drawings & Claims