PIEZOTECH ARKEMA GROUP

Ferroelectric Ink for Organic Electronics

Piezotech FC™ ink P

- Processing guide –

Technical Data

Technology	**Screen Printing**		Thickness range (µm)	1 - 20
For: Piezotech FC ink (product name)	FC ink P 20	FC ink P 25	Viscosity (mPa.s)	23000
Curie Temp. (°C)	135	120	Base Solvent(s)	Triethylphosphate
Melting Temp. (°C)	150		Typical dry content value (%)	18
Annealing Temp. (°C)	135		Boiling Point (°C)	215

Printing Data

Layers between 1µm and 20 µm can be deposited by screen printing technique.

Typical process used for a screen-printed 2µm thick layer

Materials

-Polymer: Piezotech FC ink P 20
-Substrate: PEN 125µm thick - expl: Teonex Q65HA from Dupont
-Electrodes:
- Silver ink - expl: HPS021LV from Novacentrix
- PEDOT-PSS ink - expl: Clevios SV 4 from Heraeus

Process parameters

-Blade speed: 200mm/s
-Blade pressure: 40N
-Off-contact substrate-screen distance: 1.6mm

Screen parameters - polymer layer

-Screen cloth: Polyester
-Wire diameter: 40µm
-Mesh count per cm: 100

Screen parameters – conductive layer

-Screen cloth: Stainless steel
-Wire diameter: 20µm
-Mesh count per cm: 300

Post-printing Treatment

Annealing

After deposition, the layer has to be annealed above the Curie Transition Temperature to increase crystallinity and performances.

Typical Process

For the conductive layer

1 - Hot plate / 60°C -> 3mn (solvent evaporation step)
2 - Infrared oven / 135°C -> 5mn (annealing step)

For the polymer layer

Infrared oven 135°C -> 15mn

Other possibilities

Vacuum for solvent evaporation and Conventional oven for the annealing step.

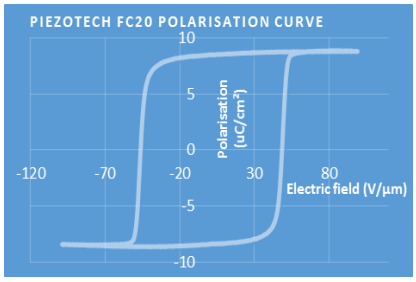
Poling

In order to acquire its piezoelectric properties, the ferroelectric layer has to be poled by applying a voltage above the coercive field.

Typical Process

-An electric field is applied according to the following cycle: :
0V/µm to $+E_{max}$, $+E_{max}$ to $-E_{max}$, $-E_{max}$ to 0V/µm
-Frequency: 0,5Hz (higher is possible)
-Number of cycles to reach 100V/µm: 15
-Signal: sinusoidal

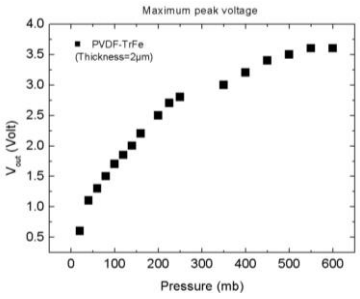
Poling can also be carried out by applying a constant electric field (after a progressive rise) for a few minutes while heating the sample



Typical polarization curve obtained with the printed Piezotech FC ink 20

Typical properties for a poled film obtained from Piezotech FC ink P 20

Relative dielectric permittivity, ε_r (1kHz)	12	Remnant polarization P_r (mC/m²)	80
Piezoelectric coefficient d_{33} (pC/N or pm/V)	-28	Coercive field (V/µm)	45
Pyro-electric coefficient, ρ, (µC/m².K)	-22	Dielectric strength (V/µm)	400



Typical electrical response for a Piezotech FC 20 printed sensor. The voltage is obtained by applying a gas flow.

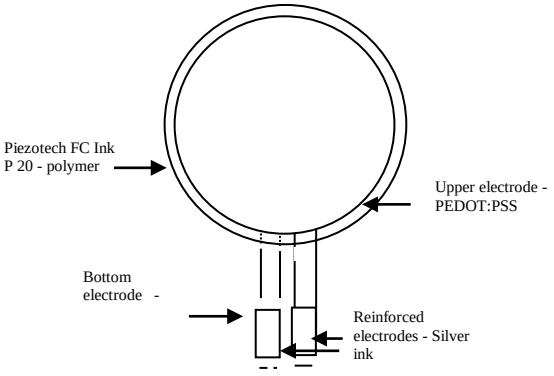
Design Concept

Polarization connection

The thin film polarization is achieved by using contact probes. In order to prevent damages to the electrodes between the probes and the metallization, reinforced electrode surfaces can be printed

Polymer / electrodes surface ratios

The surface of the printed polymer has to be larger than the electrode surface in order to avoid electrical breakdown between upper and bottom electrodes



Example of the screen printed Piezotech FC Ink P 20 layer design

Safety and Storage

Please refer to the safety datasheet

Contact Information
Piezotech
Arkema-CRRA
Rue Henri Moissan
69496 Pierre-Benite Cedex

Info.piezotech@arkema.com
Tel : +33 4 72 39 97 03
www.piezotech.eu

Disclaimer

The statements, technical information and recommendations contained herein are believed to be accurate as of the date hereof. Since the conditions and methods of use of the product and of the information referred to herein are beyond our control, ARKEMA expressly disclaims any and all liability as to any results obtained or arising from any use of the product or reliance on such information**;** NO WARRANTY OF FITNESS FOR ANY PARTICULAR PURPOSE, WARRANTY OF MERCHANTABILITY OR ANY OTHER WARRANTY, EXPRESSED OR IMPLIED, IS MADE CONCERNING THE GOODS DESCRIBED OR THE INFORMATION PROVIDED HEREIN. The information provided herein relates only to the specific product designated and may not be applicable when such product is used in combination with other materials or in any process. The user should thoroughly test any application before commercialization. Nothing contained herein constitutes a license to practice under any patent and it should not be construed as an inducement to infringe any patent and the user is advised to take appropriate steps to be sure that any proposed use of the product will not result in patent infringement. See SDS for Health & Safety Considerations.
Arkema has implemented a Medical Policy regarding the use of Arkema products in Medical Devices applications that are in contact with the body or circulating bodily fluids (http://www.arkema.com/en/social-responsibility/responsible-product-management/medical-device-policy/index.html) Arkema has designated Medical grades to be used for such Medical Device applications. Products that have not been designated as Medical grades are not authorized by Arkema for use in Medical Device applications that are in contact with the body or circulating bodily fluids. In addition, Arkema strictly prohibits the use of any Arkema products in Medical Device applications that are implanted in the body or in contact with bodily fluids or tissues for greater than 30 days. The Arkema trademarks and the Arkema name shall not be used in conjunction with customers' medical devices, including without limitation, permanent or temporary implantable devices , and customers shall not represent to anyone else, that Arkema allows, endorses or permits the use of Arkema products in such medical devices.
It is the sole responsibility of the manufacturer of the medical device to determine the suitability (including biocompatibility) of all raw materials, products and components, including any medical grade Arkema products, in order to ensure that the final end-use product is safe for its end use; performs or functions as intended; and complies with all applicable legal and regulatory requirements (FDA or other national drug agencies) It is the sole responsibility of the manufacturer of the medical device to conduct all necessary tests and inspections and to evaluate the medical device under actual end-use requirements and to adequately advise and warn purchasers, users, and/or learned intermediaries (such as physicians) of pertinent risks and fulfill any postmarket surveillance obligations. Any decision regarding the appropriateness of a particular Arkema material in a particular medical device should be based on the judgment of the manufacturer, seller, the competent authority, and the treating physician. [1]