✍ IME Flow Cell Detector and IME Flow Cell Sensor

Model IME Flow Cell Detector
Model IMELC 1010.3-FD

✝ ✝Description

✍ Electrochemical detection (ECD) in LC, HPLC and Flow Injection Analysis (FIA) offers very high selectivity based on the redox properties of the analyte to be measured, very high sensitivity, and down to picogram levels for its limit of detection. A wide variety of ionic and non-ionic compounds may be readily detected by ECD, thus making ECD a highly versatile detection technique. Conductance monitoring is also important in LC and FIA.

The IME Flow Cell Detector (FCD) and IME LC 1010.3 FD Sensor from AAI-ABTECH is one more innovation in the application of electrochemical detection to measurement problems in science and industry. The IME Flow Cell Detector is a stainless steel flow cell of known analytical volume through which the user may flow liquids over an interdigitated array sensor of gold or platinum. Using the FCD you may study electrochemical impedance, conductimetry, microelectrochemistry, of Au, Pt or polymer modified electrodes on the sensor array. The FCD comprises two main parts; a stainless steel flow cell with reference electrode and an Interdigitated Microsensor Electrode (IME or IDA) sensor device.

✝ ✝Design

✍ The Interdigitated Microsensor Electrode (IME or IDA) is a microlithographically fabricated sensor chip formed from magnetron sputtered gold or e-gun sputtered platinum on an insulating and chemically resistant borosilicate glass substrate. The sensor metallization comprises 100 Å of adhesion promoting titanium/tungsten (Ti/W) and 1,000 Å of gold or platinum.

The Model IME LC 1010.3-FD full differential sensor pattern provides four (4) separate working electrodes on the single sensor chip. These working electrodes are arranged into two (2) interdigitated microsensor array electrodes (IMEs or IDAs) or two separate sensor devices (interdigit areas) on the chip. This design permits the user to define an analyte specific interdigit area and an analytical reference interdigit area. These devices are therefore useful for the fabrication of chemical and biological sensors based on impedance or conductance. The 1010.3-FD sensor has equal digit (line) and space dimensions that are 10 ?m each and comprises 10 opposing digits per electrode bus for a total of 20 digits per sensor. In this model, each digit is ca. 3 mm long. This produces a centerline or serpentine length of ca. 5.72 cm long and a cell constant that is 0.33 cm^{-1}.

The precisely microfabricated digits of gold or platinum replaces the familiar carbon paste and bulk metal disc electrodes in electrochemical LC detection and LC conductance monitoring. Electrical connection to the chip is made via a pin-out header that is wire bonded at bonding pads and encapsulated in a chemically resistant epoxy resin.

✍ The 316 stainless steel FCD houses a Ag/AgCl, 3M Cl^- reference electrode and is electrically isolated from its base. It may thus serve as a counter electrode in electrochemistry applications. Rated to 100 psi nominal and 300 psi max., the FCD can accommodate flow rates of 0 - 100 ml/min. Interchangeable Teflon gaskets of 0.002", 0.005" and 0.015" produce analytical sample volumes of 3.4 ?l, 8.5 ?l, and 25.5 ?l for the sensor.

✝ ✝Interrogation Methods

✍ The IMELC 1010.3 FD LC Sensor may be operated by Pulsed Amperometry or Cyclic Voltammetry. In addition, the very close electrode separation (10 ?m.) and the long centerline meander length (5.98 cm) allows the use of AC Electrical Impedance and Discontinuous Small Amplitude Pulse (EPSIS) analytical methodologies.

✝ ✝Applications

Electrochemical detection may be used in ultra-trace level biochemical analyses, in the analysis of various pharmaceutical compounds, in the detection and monitoring of environmental pollutants, and in "at-line" chemical and biological process monitoring.

The IME 1010.3 FD LC Sensor is also used in materials science research of electroactive polymer films. Polymer films that are spun cast, electropolymerized or coated onto the IME LC Sensor may be analyzed by AC Electrical Impedance, DC pulse amperometry, or using EPSIS (The Electroactive Polymer Sensor Interrogation System) in a flowing stream. Changes in electrical impedance or conductivity of the film could then be monitored in response to various ionic analytes, or redox active analytes.

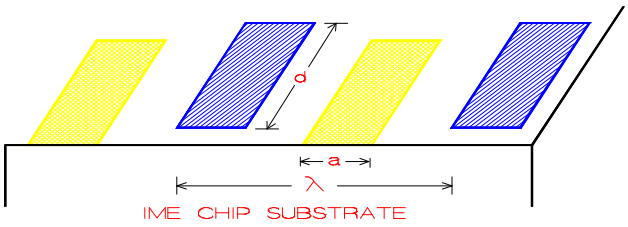
A further facility provided by the IME 1010.3 FD LC is the relative ease with which the detector may be chemically modified. The digits may be modified by platinization, amalgam formation, alkanethiols, and electroactive polymers. The interdigit space may likewise be modified using well established silane chemistries.

✍ The IME sensor devices may be coated with your particular film or coating by dip coating, spin casting, air-brush spray painting, L-B film deposition, brush painting, or by electropolymerization. Spin coating is best performed on an unpackaged chip which will require wire bonding and encapsulation by the end user.

✝ ✝To Use

✍ To use the FCD, the IME LC sensor is inserted, face upward, into the shallow cavity of the specially designed delrin holder/chuck. The sensor is clamped into the holder/chuck using a knurled screw. The holder is then mated to the polished and gasketed face of the stainless steel flow cell using guide pins on the FCD. Once in place the sensor and the holder/chuck are clamped to the flow cell using the screw-clamp quick release mechanism.

Technical Specifications



Materials of Construction

Substrate:	Schott D263 Borosilicate Glass
Dielectric Constant, $?_r$, at 1 MHz	6.7
Dielectric Loss Angle, tan ?, at 1 MHz	61 x 10^{-4}
Electrical Resistivity (50 Hz) (250?C)	1.6 x 10^{8} ? cm
Coefficient of Linear Thermal Expansion, ? $_{20\text{-}300}$,	7.2 x 10^{-6} K^{-1}
Refractive Index at 20?C, n_D (? = 546.1 nm)	1.5249
Metallization:	100 Å Ti / 1000 Å Au or Pt
*Encapsulant:	Black epoxy on header. Green or amber polyimide on the chip.
Connector Type:	Single row mini latch connector
*Pin-out on Header:	Four pins, each 10 ?m gold plated, 0.025" sq., and 0.10" on center.
*Pin-in on Connector:	Four receptacles, each 10 ?m gold plated, 0.025" sq., and 0.10" on center
*Leadwire:	Color coded, 30AWG stranded copper, shielded, and PVC jacketed.

Physical Dimensions & Constants

	1010.3-FD
IME Chip Dimensions *(l* x *w* x *t)*	
Un-packaged Sensor Chip (cm)	3.10 x 1.00 x 0.05
Packaged Sensor Chip* (cm)	4.20 x 1.25 x 0.55
No. of Digits per IME Sensor	10/bus; 20/sensor
No. of Spaces per IME Sensor	19
Digits Pairs, N, per IME Sensor	10
Digit (line) Length, d, (?m):	2,990 (ca. 3mm)
Digit (line) Width, a, (?m):	10
Interdigit Space Length, d', (?m):	3,000 (3 mm)
Interdigit Space, a, (?m):	10
Spatial Periodicity, ?, (?m):	40
Zaretsky[1,2] Meander Length, M:	2.99 cm
Center Line or Serpentine Length:	5.72 cm
Cell Constant[3] (cm^{-1}):	0.33
Electrode Areas (cm^2)	
Analyte Specific Sensor ANA1 (Black):	3.03 x 10^{-3}
Analyte Specific Sensor ANA4 (White):	3.03 x 10^{-3}
Analytical Reference Sensor REF2 (Red):	3.03 x 10^{-3}
Analytical Reference Sensor REF3 (Green):	3.03 x 10^{-3}
TOTAL ELECTROACTIVE METAL EXPOSED:	**1.21 x 10^{-2}**

Flow Cell Detector

Flow Cell pressure Rating (psi)	100 nominal, 300 max.
Gasket	Fluoropolymer
Thickness (mils)/Volume (?l)	0.002"/3.4 ?l; 0.005"/8.5 ?l; 0.015"/25.5 ?l
Flow Rates (ml/min.)	0 - 100

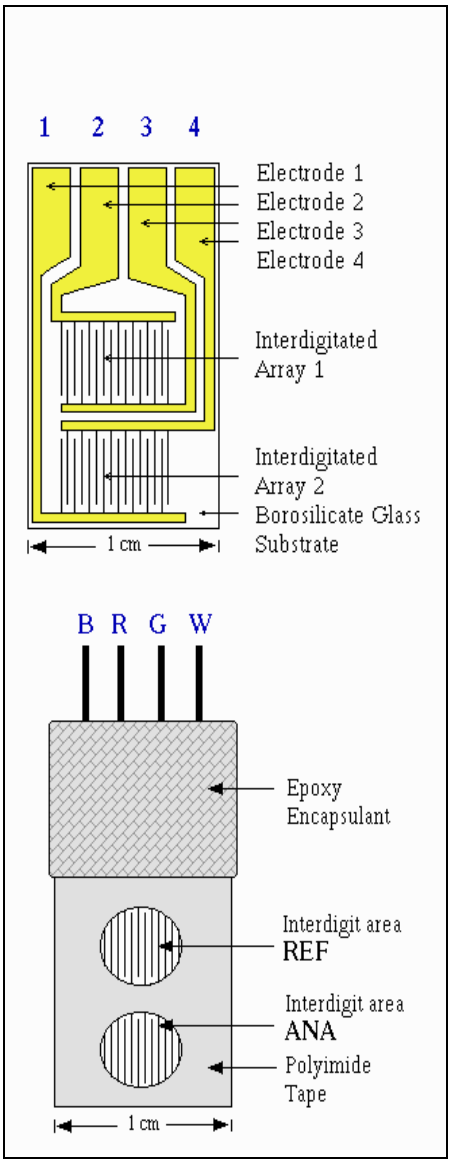
References and Notes

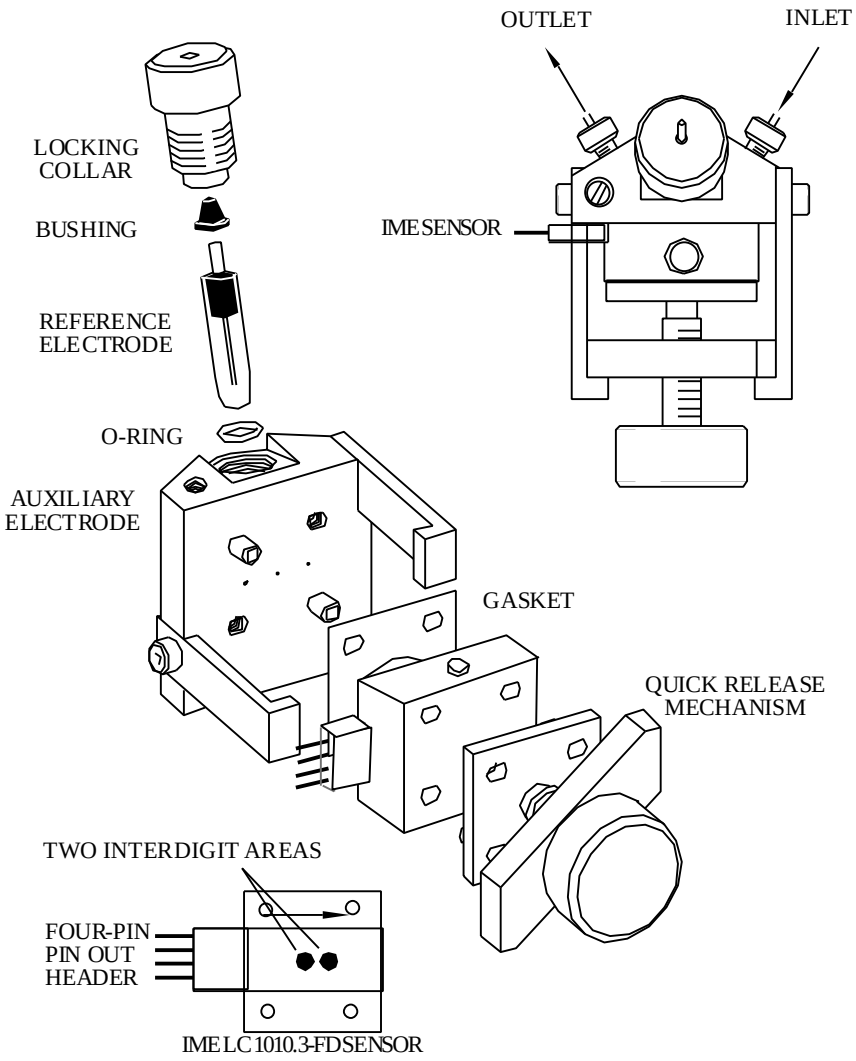
1. Zaretsky, M. C.; Mouyad, L.; Melcher, J. R. *IEEE Trans. Electr. Insul.* **1988**, *23*, 897.

2. The Zaretsky convention defines; M = N d

3. Sheppard, N. F.; Tucker, R. C.; Wu, C. "Electrical Conductivity Measurements Using Microfabricated Interdigitated Electrodes" *Anal. Chem.* **1993**, *65*, 1199.

General Ordering Information





IME Flow Cell Detector and IME Flow Cell Sensors

Model IME Flow Cell Detector

Flow Cell Sensor	**GOLD**	**PLATINUM**
Full Differential, packaged	IMELC Au-1010.3-FD	IMELC Pt-1010.3-FD