Flame Thermionic Ionization (FTID) – Samples are decomposed in a self-sustained Hydrogen-Air or Hydrogen-Methane-Air flame, and the neutral decomposition products are re-ionized and detected by a thermionic ion source and collector located well downstream of the flame.

Catalytic Combustion Ionization (CCID) – Hydrocarbon and Fatty Acid Methyl Ester (FAME) compounds containing large concentrations of CH_2 functional groups are selectively detected by forming momentary bursts of flame ignition as each compound impacts a hot catalytic ceramic surface in a detector environment containing Oxygen.

Tandem Thermionic or Thermionic/Flame Ionization (Tandem TID, Tandem TID/FID) – Two different detector stages are combined in series, and many different combinations are possible depending on the choices of ionizing elements and detector gases used in each stage. In some cases, the first detection stage is non-destructive, while in other cases, a destructive process in the first stage may be used to generate decomposition products that are then detected in the second stage.

Reactor Thermionic Ionization Analysis (RTIA) - In an non-GC implementation of thermionic detection, a thermionic ionization transducer is preceded by a heated reactor chamber. The transducer detects selective vapors thermally evolved from liquid or solid samples heated in the reactor. When the gas flowing throught the reactor and transducer is Air or Oxygen, detected vapors include volatilized sample constituents as well as products of oxidation of the sample constituents.

INTERCHANGEABLE ION SOURCE ELEMENT CHOICES:

TID-2 (Black Ceramic) – selective NPD detection with negligible tailing of P peaks;

TID-4 (White Ceramic) – selective NPD detection with the best possible N response;

TID-1 (Very White Ceramic) – selective detection of Oxygenates, Nitro compounds, some Halogenates, Pyrrole versus Pyridine functional groups, and Methylene groups in linear chain Hydrocarbons and Fatty Acid Methyl Ester (FAME) compounds;

TID-3 (White Ceramic) – selective detection of volatile Halogenates like Trihalomethanes;

TID-5 (Black Ceramic) – selective detection of Br and I compounds with suppressed Cl;

TID-6 (Blue Gray Ceramic) – selective detection of P compounds with suppressed N;

TID-7 (NEW Green Black Ceramic)- selective detection of Halogenates like PCBs;

CFID (Black Ceramic) – used with the Remote FID mode for selective detection of P, Pb, Sn, or Si compounds;

FID Probe (Uncoated Bare Wire) – used as flame ignitor/polarizer for universal FID detection.

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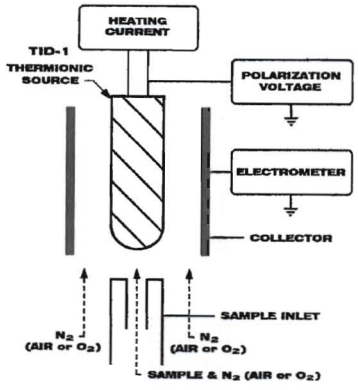
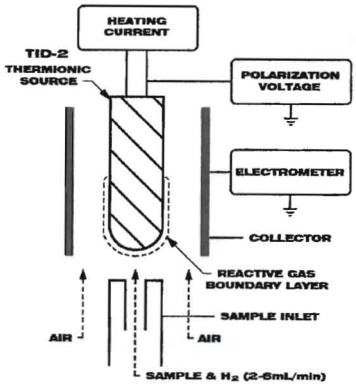
GC DETECTOR INNOVATIONS by DET

(different implementations of the same basic detector geometry)

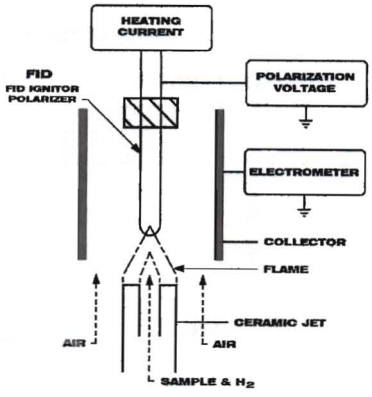
TID



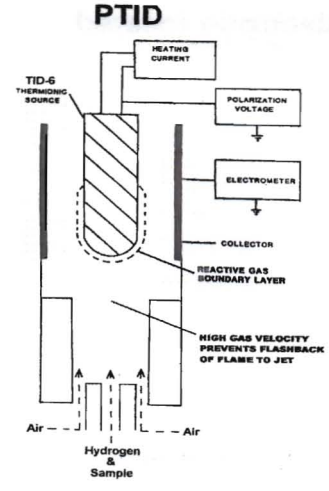
NPD



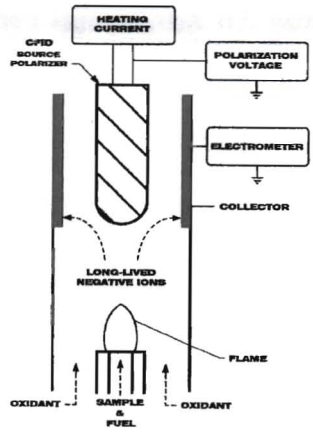
FID



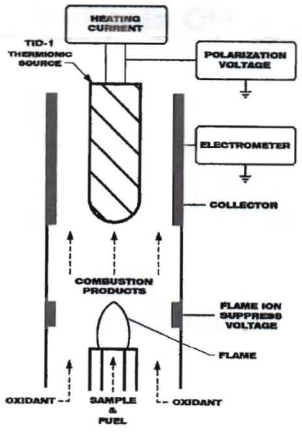
PTID



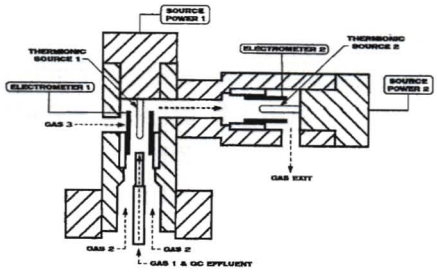
REMOTE FID



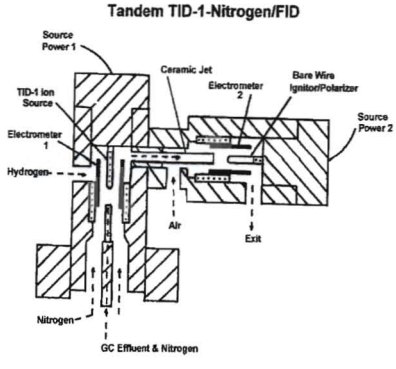
FTID



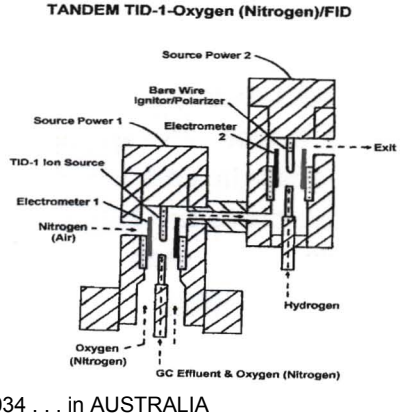
TANDEM TID



TANDEM TID-Nitrogen/FID



TANDEM TID-Oxygen/FID



DET RETROFIT NPD/TID/FID TOWER ASSEMBLY THAT MOUNTS ONTO THE FID/TSD BASE ON VARIAN GC MODELS AND USES VARIAN TSD ELECTRONICS ($1550):

Accommodates the same ionizing elements as the Thermo retrofit. 10 times improvement in signal to noise achieved for TID modes by substituting the stand-alone DET Current Supply for Varian's TSD power supply.

DET RETROFIT NPD/TID/FID TOWER ASSEMBLY THAT MOUNTS ONTO THE FID/NPD BASE ON SRI INSTRUMENTS GC MODELS ($2350):

Accommodates the same ionizing elements as the Thermo retrofit. NPD, TID, and FID modes can be powered by SRI NPD electronics, but better user friendly precision control is provided by the stand-alone DET Current Supply.

DET RETROFIT NPD/TID/REMOTE FID TOWER ASSEMBLY THAT MOUNTS ONTO THE FID/NPD BASE ON AN HP 5890 ($1850):

Accommodates the same ionizing elements as the Thermo retrofit, plus a CFID (Black Ceramic) type source for use in an exclusive Remote FID detection mode which is selective for P, Pb, Sn, or Si compounds. DET hardware IS NOT compatible with 5890 detector electronics, so the stand-alone DET Current Supply ($1760) and a stand-alone Electrometer (Keithley 6485 picoammeter, $1800) are also required.

APPLICATION EXAMPLES USING DET RETROFIT EQUIPMENT:

sub-picogram NPD detection of pesticides and drugs of abuse;

femtogram TID-1 sensitivity for Nitro explosives like 2,4-Dinitrotoluene and TNT, as well as Nitro pesticides like Methyl Parathion;

sub-picogram TID-1 detection for some Halogenated pesticides like Heptachlor, Dieldrin, Chlordane, Pentachlorophenol, and Atrazine;

low picogram TID-3 detection of Trihalomethanes in drinking water;

selective TID-1 detection of Ethanol and other Alcohols in petroleum and biofuels;

selective TID-1 detection of Acetic, Formic, and other Carboxylic Acids in wine and other food and flavor analyses;

picogram TID-1 detection of BisPhenol (BPA) and Phthalates in food packaging products;

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VISIT DET at PITTCON 2011, March 13 – 17, Atlanta, Georgia, USA
Booth 4078 Sunday Poster 180-16P

CHEMICAL DETECTION PRODUCTS by DET featuring novel applications of the principles of THERMIONIC SURFACE IONIZATION and FLAME IONIZATION

GC detectors and stand-alone transducers manufactured by DET all have an original common design feature consisting of an electrically heated, cylindrically shaped ion source element positioned on the axis of an ion collector cylinder. Ion source elements are fabricated from proprietary ceramic coatings; are mounted on a flange for easy self-aligning installation into detector tower structures; and are available with different ceramic coatings for multiple modes of chemical detection using the same basic equipment.

DETECTION PRINCIPLES USED IN DET PRODUCTS:

Thermionic Surface Ionization (TID & NPD) – Samples form gas phase negative ions by extraction of electrons from a hot, catalytically active solid surface. Key parameters are the surface composition, surface temperature, gas composition around the surface, and polarization of the surface relative to a surrounding ion collector. Multiple detection modes are obtained through systematic changes in these four parameters. Some modes, like the widely used NPD, combine reactive gas phase chemistry to decompose incoming samples, and then ionize the decomposition products by interaction with the surface. In other modes, intact sample molecules are ionized by direct impact with the surface with no intervening gas phase chemistry.

Conventional Flame Ionization (FID) – Samples decompose and form ions in gas phase reactions with radical species like H, O, and OH that are present in self-sustained Hydrogen-Air flames. A polarizer voltage and ion collector located near the flame effectively measure ions formed by combustion of organic compounds.

Remote Flame Ionization (RFID) – Like an FID, samples are decomposed in a self-sustained flame, but the polarizer and collector electrode are located further downstream of the flame. In this detection, hydrocarbon ions dissipate by recombination processes near the flame, and only long lived ion species remain to be selectively measured at the collector. Detectable ion species include decomposition products of compounds containing P, Pb, Sn, or Si atoms, and the selectivity versus Hydrocarbon interferences is greatly improved by using a Hydrogen-Methane-Air fueled flame.

DETECTOR HARDWARE STRUCTURES by DET
(visit DET at Pittcon 2011, booth 4078)

GC DETECTOR TOWER CONFIGURATIONS:

NPD/TID/FID Tower Structure – This type of detector structure includes a ceramic tipped jet and a tower assembly that positions an ion source and collector electrode in close proximity to the top of the jet. Selective NPD and TID, and universal FID modes of detection are available depending on the choice of ion source element and the detector gases.

NPD/TID/Remote FID Tower Structure – This type of detector structure includes a wide bore jet, and a tower assembly that positions the ion source and collector electrode several centimeters downstream of the top of the jet. The internal diameter of the jet is sufficient to allow fused silica columns of 0.53 mm diameter or less to be inserted clear through the jet. For NPD and TID modes of detection, the GC column is terminated above the jet in close proximity to the ion source/collector. For the Remote FID mode of detection, the column end terminates right at the top of the jet, a self-sustaining flame is ignited at the jet, and long lived ions formed in the flame are carried downstream to the ion collector.

NPD/TID/Remote FID/FTID Tower Structure – This type of detector structure is similar to the Remote FID structure except it has an additional Ion Suppress electrode located near the top of the flame jet. The purpose of the Ion Suppress is to prevent ions formed in a flame at the jet from moving downstream to the ion collector. Remote FID detection is also achieved by turning Off the Ion Suppress voltage.

NPD/TID/PTID Tower Structure – This type of detector structure is similar to the Remote FID structure except it has a small restricted internal diameter between the jet and ion source that produces a high gas velocity to prevent a flame front formed at the hot ion source from flashing back to a self-sustained flame at the jet.

Tandem TID & Tandem TID/FID Tower Structure – This detector structure consists of 2 detection stages coupled together in a series combination. The first stage is either an NPD/TID/FID tower or Remote FID Tower each modified with an auxiliary gas flow input to sweep any dead volume between the 2 stages. The second detection stage can be either an NPD/TID transducer or an FID transducer. In the case of an FID transducer in the second stage, another auxiliary gas input is provided to achieve the appropriate fuel mixture for a self-sustaining flame.

STAND-ALONE DETECTOR STRUCTURES:

DET tower structures can be configured with various choices and sizes of either Swage or Tube Inlets and Outlets for use as stand-alone transducers. A mounting flange is available to attach to the transducers, as well as Aluminum heater blocks. A transducer attached to a heated inlet reactor is used in DET's Reactor Thermionic Ionization Analyzer (RTIA) module for selective screening applications.

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GC DETECTION IDEAS FROM DETECTOR ENGINEERING & TECHNOLOGY

RETROFIT THERMIONIC IONIZATION DETECTORS ADD NEW APPLICATIONS AND EXTEND USEFUL LIFE FOR EXISTING AGILENT, THERMO, VARIAN, SRI, AND HP 5890 GC MODELS

DET has developed a family of inexpensive GC detectors that operate according to the principles of Thermionic Surface Ionization and Flame Ionization, and that feature ion source elements made of proprietary ceramic materials. The ion sources are a standard mounting design identical to that used on Agilent 6890/7890 NPD equipment, and are interchangeable in compact detector tower structures designed to custom mount onto existing FID/NPD bases on different model GC instruments.

DET ION SOURCE TYPES FOR USE IN AGILENT 6890/7890 NPD EQUIPMENT ($350 each):

TID-2 (Black ceramic) – selective NP detection with negligible tailing of P peaks;

TID-4 (White Ceramic) – selective NP detection with best possible N response;

TID-1 (Very White Ceramic) - selective detection of Oxygenates, Nitro compounds, some Halogenates, Pyrrole versus Pyridine functional groups, and Methylene groups in linear chain Hydrocarbons and Fatty Acid Methyl Ester (FAME) compounds;

TID-3 (White Ceramic) - selective detection of volatile Halogenates like Trihalomethanes;

TID-5 (Black Ceramic) - selective detection of Br and I compounds with suppressed Cl;

TID-6 (Blue Gray Ceramic) - selective detection of P compounds with suppressed N;

TID-7 (NEW Green Black Ceramic) - selective detection of Halogenates like PCBs.

STAND-ALONE DET CURRENT SUPPLY FOR IMPROVED NPD AND TID DETECTION ON AGILENT 6890/7890 GC MODELS ($1760):

Provides optimum Constant Current heating of NPD and TID ion sources, and variable polarization voltages for 10 times signal to noise enhancement for TID detection modes.

DET RETROFIT NPD/TID/FID TOWER ASSEMBLY THAT MOUNTS ONTO THE NPD BASE ON A THERMO SCIENTIFIC TRACE GC AND USES THERMO NPD ELECTRONICS ($1800):

Accommodates any of the interchangeable ion source types listed above plus a bare wire probe for universal FID detection. Combination of DET hardware and Thermo NPD electronics provides unmatched performance capability for all modes of detection.