CLAIM(S):

1. A method for determining and classifying by type aircraft air contaminants, the method comprising:

(a) passing a sample of aircraft air through an aircraft air contaminant analyzer and through at least one aircraft air contaminant collector along a first sample flow path at a first sample flow rate and/or at a first sample flow duration, while passing another sample of aircraft air through the aircraft air contaminant analyzer and through a bypass section along a second sample flow path bypassing the at least one aircraft air contaminant collector at a second sample flow rate and/or at a second sample flow duration,

the at least one aircraft air contaminant collector comprising:

(i) a microporous medium comprising microporous flow-through channels arranged across the first sample flow path, the microporous medium having a chemoselective coating; and,

(ii) a thin film resistive heater, capable of heating to a temperature that vaporizes captured air contaminants, wherein the heater is in contact with the microporous medium;

the aircraft air contaminant analyzer also including a gravimetric sensor arranged to generate a proportionate resonant frequency response when air contaminant mass is added to or removed from the gravimetric sensor, for classifying air contaminant type; and

wherein the bypass section comprises a bypass channel, the bypass channel including the second sample flow path;

(a') the aircraft air contaminant analyzer further comprising:

a first pump generating flow along the first sample flow path; and

a second pump generating flow along the second sample flow path;

(b) controlling the first sample flow rate and/or the first sample flow duration through the at least one aircraft air contaminant collector along the first sample flow path while independently controlling the second sample flow rate and/or the second sample flow duration through the bypass section along the second sample flow path, wherein the first sample flow rate and/or the first sample flow duration is/are initially set at a low value for a first measurement of response signal magnitude;

(c) capturing air contaminants by the microporous medium;

(d) discontinuing passing aircraft air through the at least one aircraft air contaminant collector along the first sample flow path;

(e) heating the microporous medium to a temperature sufficient to vaporize the captured air contaminants and desorb the captured air contaminants;

(f) receiving the desorbed air contaminants on the gravimetric sensor arranged to generate a proportionate resonant frequency response when air contaminant mass is added to or removed from the gravimetric sensor;

(g) measuring the proportionate resonant frequency response generated by the gravimetric sensor as the air contaminant is added to and removed from the gravimetric sensor, determining the signal magnitude from the proportionate resonant frequency response, determining the air contaminant concentration, classifying the air contaminant type, and outputting the determined air contaminant concentration and classified air contaminant type;

(h) executing an air contaminant recognition program stored upon a computer-readable medium, including calculating air contaminant concentration using the measured signal magnitudes and first sample flow rates and the first sample flow duration along the first sample flow path;

(i) determining a target level for the signal magnitude, and continuously repeating (b)-(h) and measuring response signal magnitudes and adjusting the first sample flow rate and/or the first sample flow

duration based upon the previously measured signal magnitude such that

the first sample flow rate and/or the first sample flow duration is increased when the signal magnitude is lower than the target level, by an amount proportionate to how much lower the signal magnitude is below the target level, to maintain the signal magnitude at the target level, and

the first sample flow rate and/or the first sample flow duration is decreased when signal magnitude is higher than the target level, by an amount proportionate to how much higher the signal magnitude is above the target level, to maintain the signal magnitude at the target value;

(j) executing the air contaminant recognition program stored upon the computer-readable medium, including calculating air contaminant concentration using the measured signal magnitudes and first sample flow rates and/or the first sample flow durations along the first sample flow path; and,

(k) outputting the determined air contaminant concentration and air contaminant type.

2. A method for determining and classifying by type aircraft air contaminants, the method comprising:

(a) passing a sample of aircraft air through an aircraft air contaminant analyzer and through at least one aircraft air contaminant collector along a first sample flow path at a first sample flow rate and/or at a first sample flow duration, while passing another sample of aircraft air through the aircraft air contaminant analyzer and through a bypass section along a second sample flow path bypassing the at least one aircraft air contaminant collector at a second sample flow rate and/or at a second sample flow duration,

the at least one aircraft air contaminant collector comprising:

(i) a microporous medium comprising microporous flow-through channels arranged across the first sample flow path, the microporous medium having a chemoselective coating; and,

(ii) a thin film resistive heater, capable of heating to a temperature that vaporizes captured air contaminants, wherein the heater is in contact with the microporous medium;

the aircraft air contaminant analyzer also including a gravimetric sensor arranged to generate a proportionate resonant frequency response when air contaminant mass is added to or removed from the gravimetric sensor, for classifying air contaminant type; and

wherein the bypass section comprises a bypass channel, the bypass channel including the second sample flow path;

(a') the aircraft air contaminant analyzer further comprising:

a first pump generating flow along the first sample flow path; and

a second pump generating flow along the second sample flow path;

(b) controlling the first sample flow rate and/or the first sample flow duration through the at least one aircraft air contaminant collector along the first sample flow path while independently controlling the second sample flow rate and/or the second sample flow duration through the bypass section along the second sample flow path, wherein the first sample flow rate and/or the first sample flow duration is/are initially set at a low value for a first measurement of response signal magnitude;

(c) capturing air contaminants by the microporous medium;

(d) discontinuing passing aircraft air through the at least one aircraft air contaminant collector along the first sample flow path;

(e) heating the microporous medium to a temperature sufficient to vaporize the captured air contaminants and desorb the captured air contaminants;

(f) receiving the desorbed air contaminants on the gravimetric sensor arranged to generate a proportionate resonant frequency response when

air contaminant mass is added to or removed from the gravimetric sensor;

(g) measuring the proportionate resonant frequency response generated by the gravimetric sensor as the air contaminant is added to and removed from the gravimetric sensor, determining signal magnitude from the proportionate resonant frequency response, determining the air contaminant concentration, classifying the air contaminant type, and outputting the determined air contaminant concentration and classified air contaminant type;

(h) executing an air contaminant recognition program stored upon a computer-readable medium, including calculating air contaminant concentration using the measured signal magnitudes and first sample flow rates and the first sample flow duration along the first sample flow path;

(i) determining an upper threshold and a lower threshold for the signal magnitude for the contaminant type and continuously repeating (b)-(h) and measuring response signal magnitudes and adjusting the first sample flow rate and/or the first sample flow duration based upon the previously measured signal magnitude such that

the first sample flow rate and/or the first sample flow duration is increased when the signal magnitude is lower than the lower threshold, to the next pre-determined higher sensitivity level, to maintain the signal magnitude between the upper threshold and the lower threshold,

and

the first sample flow rate and/or the first sample flow duration is decreased when signal magnitude is higher than the upper threshold, to the next pre-determined lower sensitivity level, to maintain the signal magnitude to maintain the signal magnitude between the upper threshold and the lower threshold;

(k) executing the air contaminant recognition program stored upon the computer-readable medium, including calculating air contaminant concentration using the measured signal magnitudes and first sample

flow rates and the first sample flow duration along the first sample flow path; and,

(l) outputting the determined air contaminant concentration and air contaminant type.

3. The method of claim 1 or 2, wherein the air contaminants comprise aerosols.

4. The method of any one of claims 1-3, wherein the air contaminants comprise particulates.

5. The method of any one of claims 1-4, wherein the air contaminants comprise gases.

6. An aircraft air contaminant analyzer comprising:

(a) at least one aircraft air contaminant collector comprising:

(i) a microporous medium comprising microporous flow-through channels and a chemoselective coating, wherein the microporous medium remains functional and desorbs captured air contaminants while being heated for a controlled time period;

(ii) a thin film resistive heater, capable of heating to a temperature that vaporizes captured air contaminants, wherein the heater is in contact with the microporous medium;

(b) a bypass section, comprising a bypass channel;

(c) a first substrate, having a top surface and a bottom surface; wherein the contaminant collector is associated with the first substrate, the microporous medium and heater being thermally insulated from the first substrate;

(d) a gravimetric sensor arranged to generate a proportionate resonant frequency response when air contaminant mass is added to or removed from the gravimetric sensor, for classifying air contaminant type;

(e) a second substrate, having a top surface and a bottom surface; wherein the gravimetric sensor is associated with the top surface of the second substrate, the gravimetric sensor being separated from the contaminant collector by a constant distance, the gravimetric sensor being arranged

to receive air contaminants desorbed from the membrane when the membrane is heated;

(f) a support comprising a top surface and a bottom surface, the support comprising at least one aircraft air inlet port and a bypass inlet port, the at least one aircraft air inlet port, and the bypass inlet port passing through the top surface and the bottom surface of the support, wherein the bottom surface of the second substrate is associated with the top surface of the support;

(g) a first sample flow path, passing through the at least one aircraft air contaminant collector;

(h) a second sample flow path, bypassing the at least one aircraft air contaminant collector;

(i) a first pump, arranged to generate flow of aircraft air along the first sample flow path through the at least one aircraft air inlet port and through the at least one air contaminant collector before and after the microporous medium is heated;

(j) a second pump arranged to generate flow of aircraft air through the bypass inlet port along the second sample flow path through the bypass section and the bypass channel;

(k) a resonant frequency measurement device, arranged to measure the proportionate resonant frequency response generated by the gravimetric sensor as the air contaminant is added to and removed from the gravimetric sensor;

(l) a computer readable medium bearing an air contaminant recognition program and calibration data;

(m) a processor configured to execute the air contaminant recognition program, the contaminant recognition program including a module configured to classify the air contaminant by type and to measure response signal magnitudes, and a module programmed to use the calibration data for comparison with magnitude of the proportionate resonant frequency response generated by the gravimetric sensor to calculate air contaminant concentration and to determine a target value for air contaminant type, and to used measured response magnitudes to

adjust first sample flow rates and/or first sample flow durations based upon previously measured response magnitudes.