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(54) SAMPLE ANALYSIS SYSTEM WITH PHASE-BASED TARGET IDENTIFICATION AND EXTRACTION

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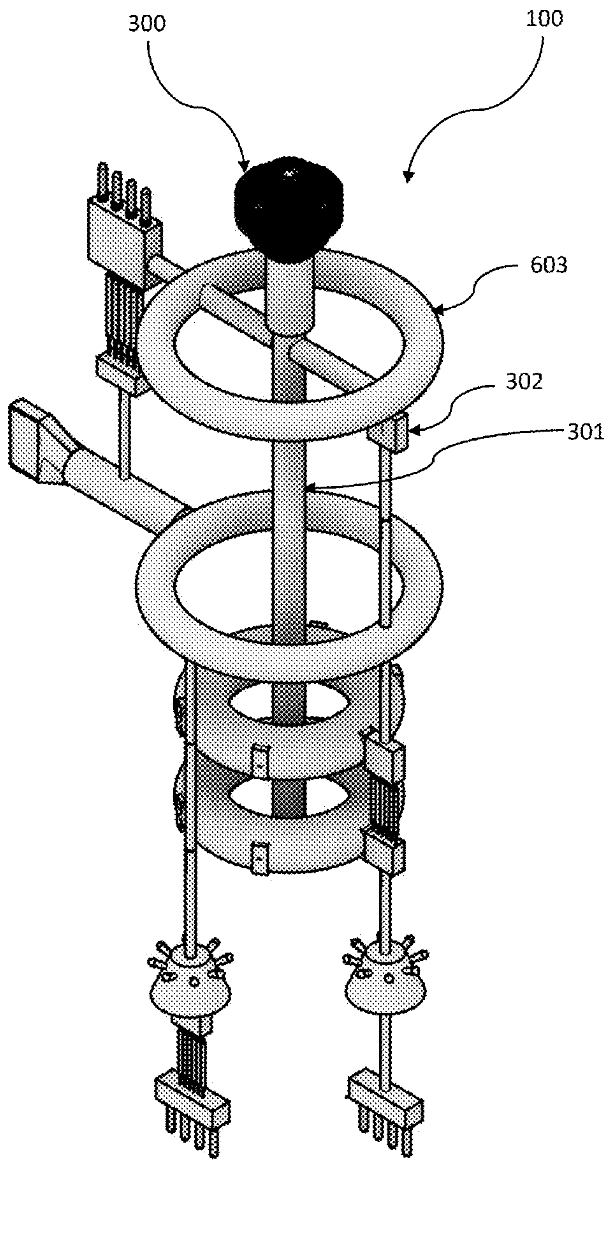
CPC ***G01N 35/00732*** (2013.01); ***G01N 30/06*** (2013.01); *G01N 2035/0437* (2013.01)

(57) **ABSTRACT**

Embodiments of the present disclosure relate to an automated and remote system for collecting and analyzing one or more samples over time. The system includes an analysis module that performs a cycle of operations, which includes selecting a phase analyte of the sample in a phase module, identifying a target product from the phase analyte in a component module, and extracting the target product from the phase analyte in one or more extraction modules. The system also includes a device that interfaces with the analysis module and includes a processor that activates one or more of the extraction modules during the cycle of operations. The one or more extraction modules are configured to reduce the phase analyte purity to a predetermined level during the cycle of operations.



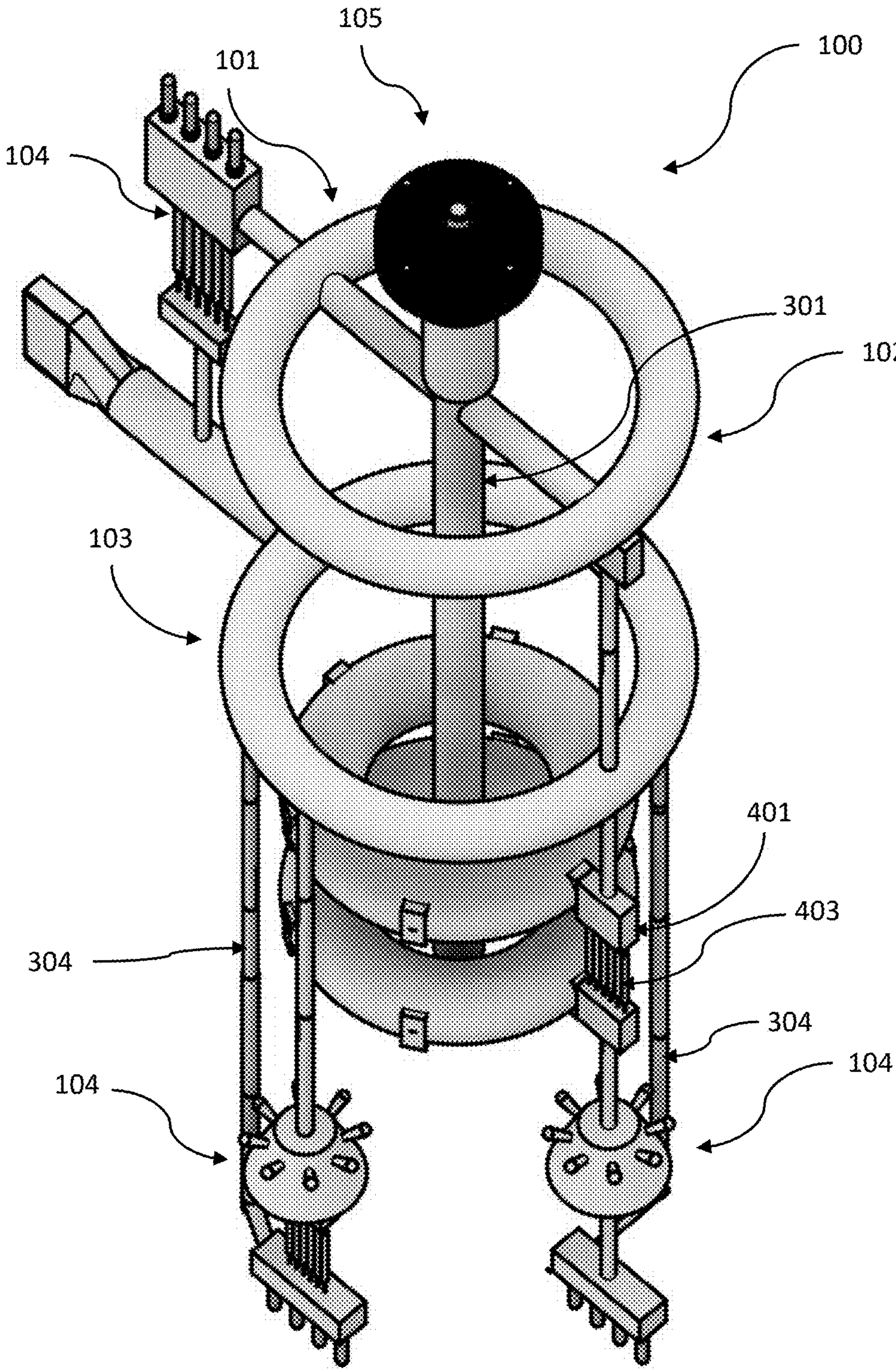


Fig. 1

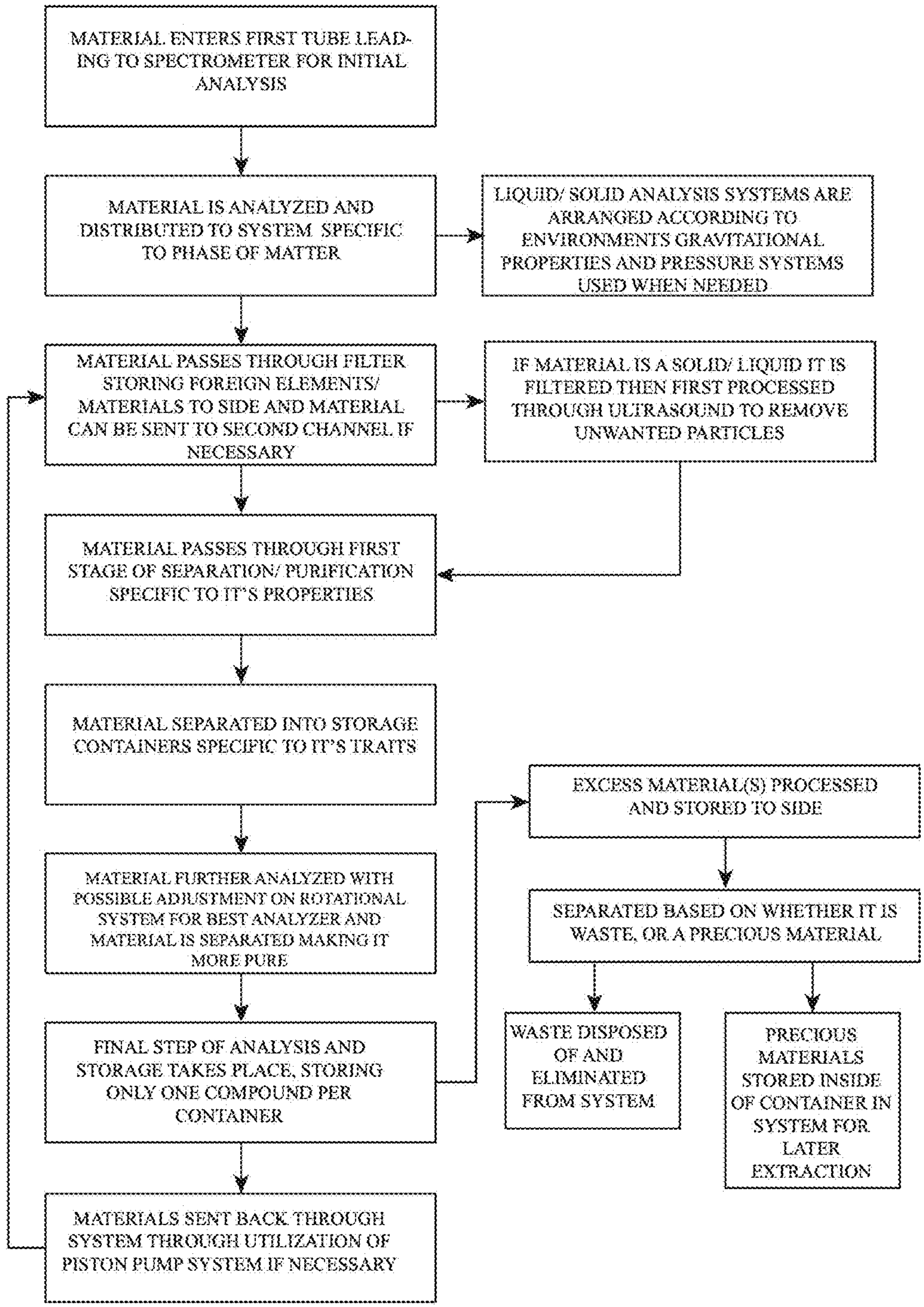

MATERIAL ENTERS FIRST TUBE LEADING TO SPECTROMETER FOR INITIAL ANALYSIS
MATERIAL IS ANALYZED AND DISTRIBUTED TO SYSTEM SPECIFIC TO PHASE OF MATTER
LIQUID/ SOLID ANALYSIS SYSTEMS ARE ARRANGED ACCORDING TO ENVIRONMENTS GRAVITATIONAL PROPERTIES AND PRESSURE SYSTEMS USED WHEN NEEDED
MATERIAL PASSES THROUGH FILTER STORING FOREIGN ELEMENTS/ MATERIALS TO SIDE AND MATERIAL CAN BE SENT TO SECOND CHANNEL IF NECESSARY
IF MATERIAL IS A SOLID/ LIQUID IT IS FILTERED THEN FIRST PROCESSED THROUGH ULTRASOUND TO REMOVE UNWANTED PARTICLES
MATERIAL PASSES THROUGH FIRST STAGE OF SEPARATION/ PURIFICATION SPECIFIC TO IT'S PROPERTIES
MATERIAL SEPARATED INTO STORAGE CONTAINERS SPECIFIC TO IT'S TRAITS
EXCESS MATERIAL(S) PROCESSED AND STORED TO SIDE
MATERIAL FURTHER ANALYZED WITH POSSIBLE ADJUSTMENT ON ROTATIONAL SYSTEM FOR BEST ANALYZER AND MATERIAL IS SEPARATED MAKING IT MORE PURE
SEPARATED BASED ON WHETHER IT IS WASTE, OR A PRECIOUS MATERIAL
FINAL STEP OF ANALYSIS AND STORAGE TAKES PLACE, STORING ONLY ONE COMPOUND PER CONTAINER
WASTE DISPOSED OF AND ELIMINATED FROM SYSTEM
PRECIOUS MATERIALS STORED INSIDE OF CONTAINER IN SYSTEM FOR LATER EXTRACTION
MATERIALS SENT BACK THROUGH SYSTEM THROUGH UTILIZATION OF PISTON PUMP SYSTEM IF NECESSARY

Fig. 2

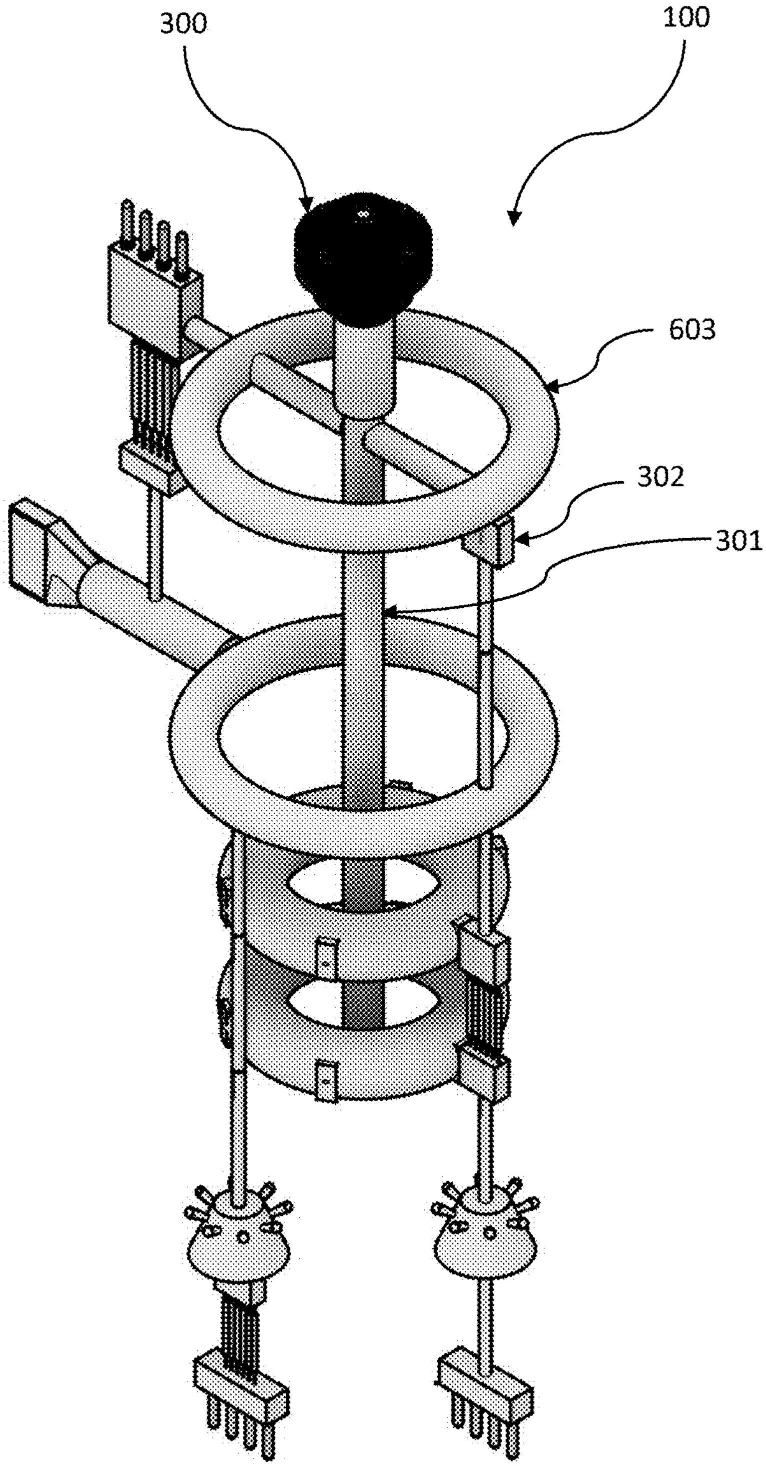


Fig. 3

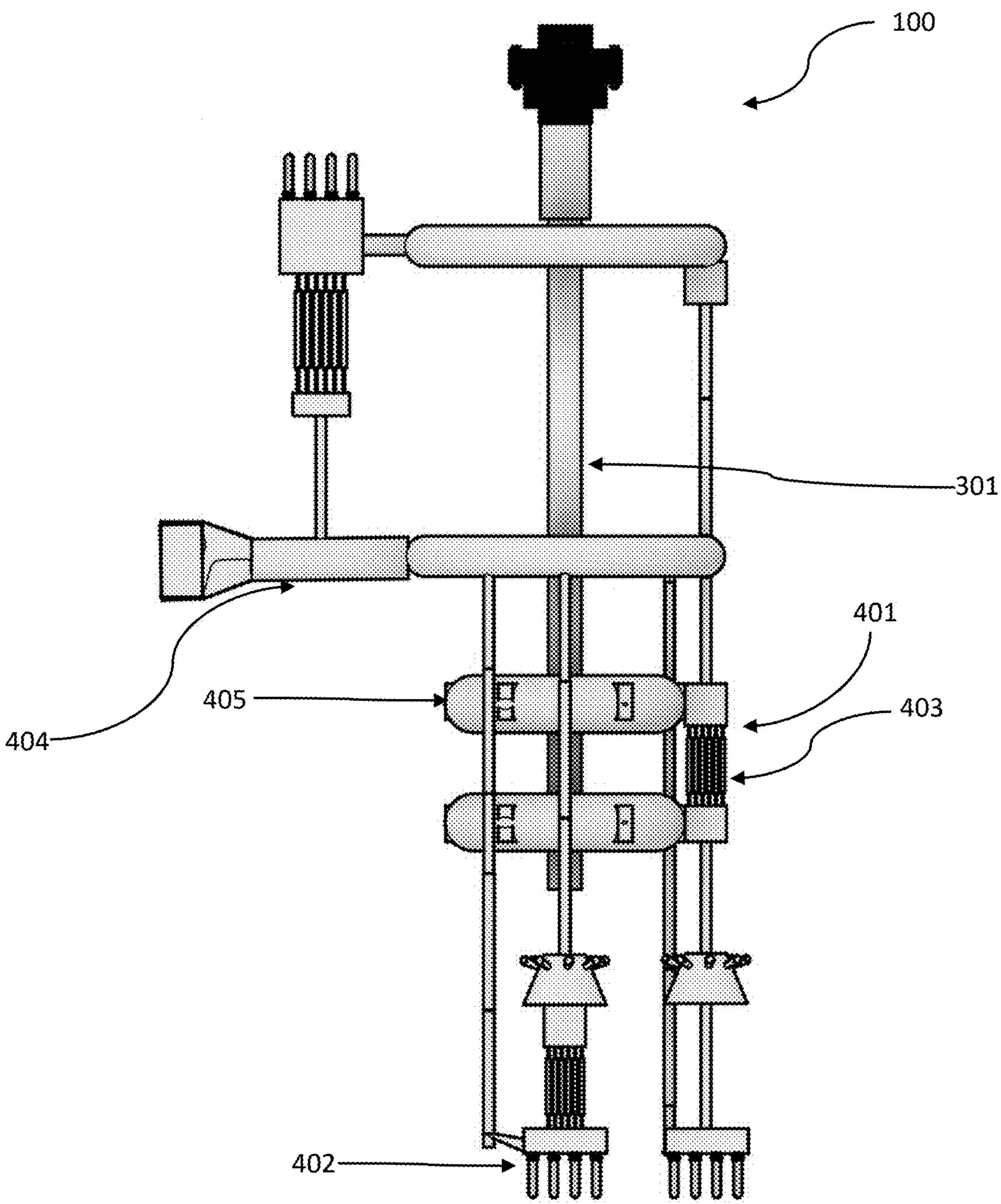


Fig. 4

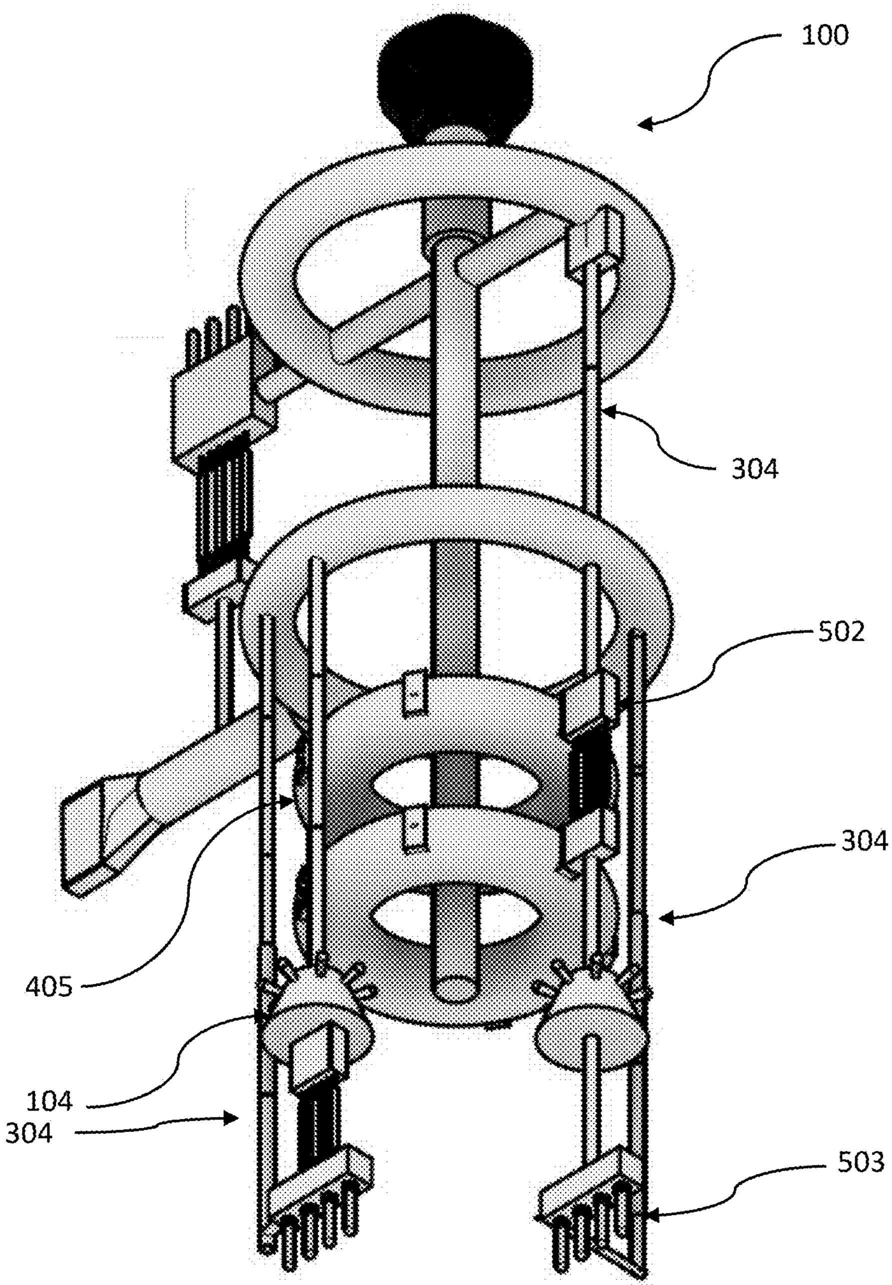


Fig. 5

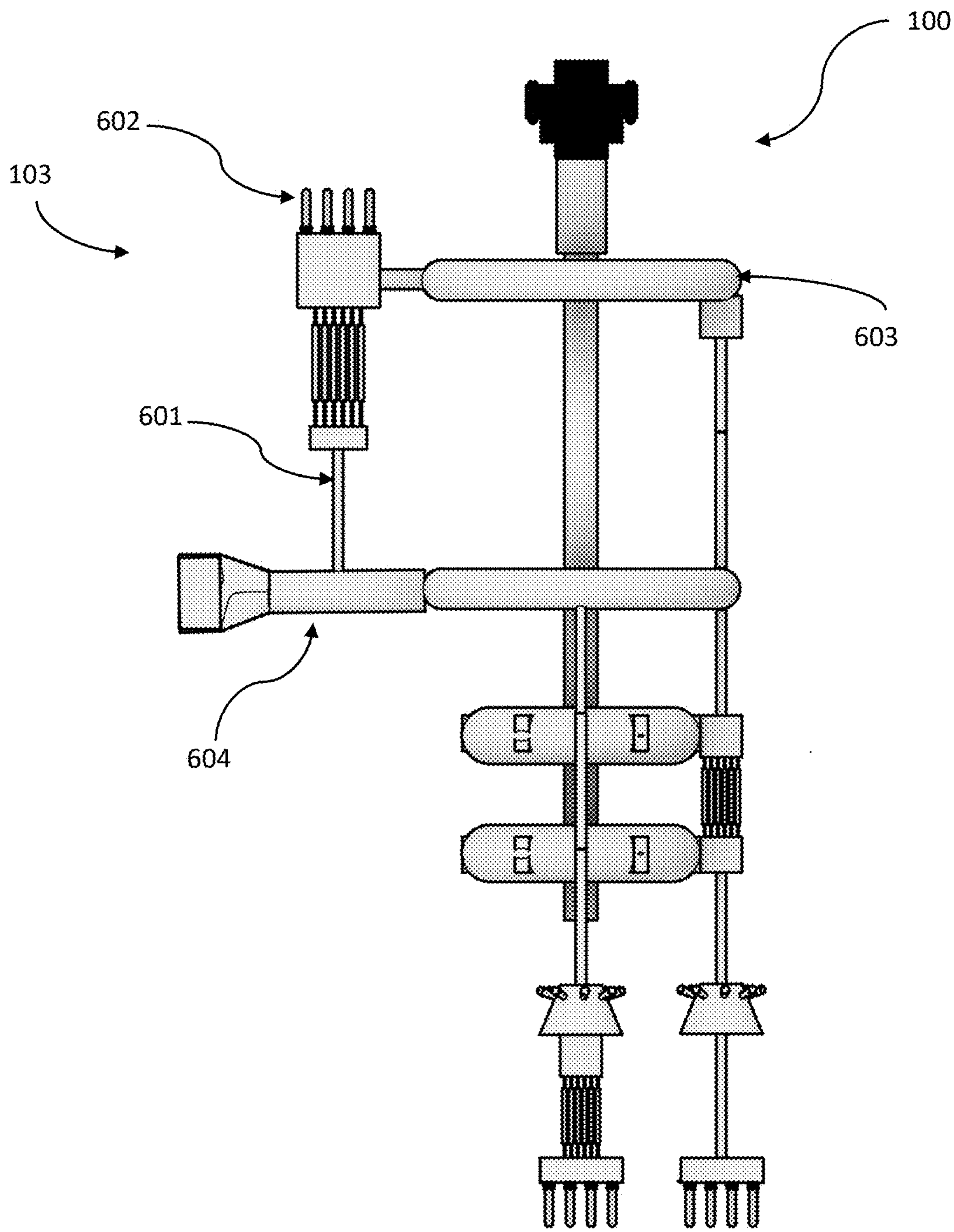


Fig. 6

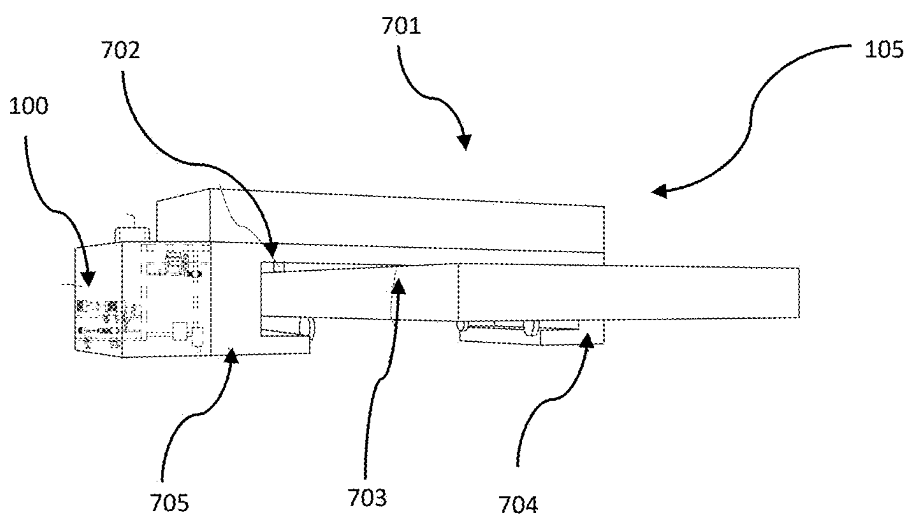


Fig. 7

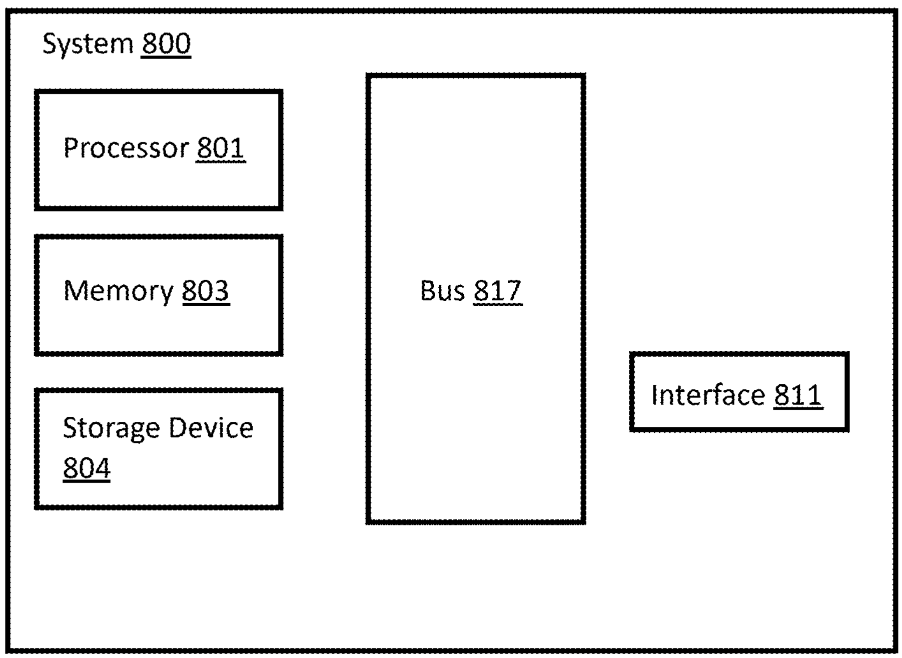

System 800
Processor 801
Memory 803
Storage Device 804
Bus 817
Interface 811

Fig. 8

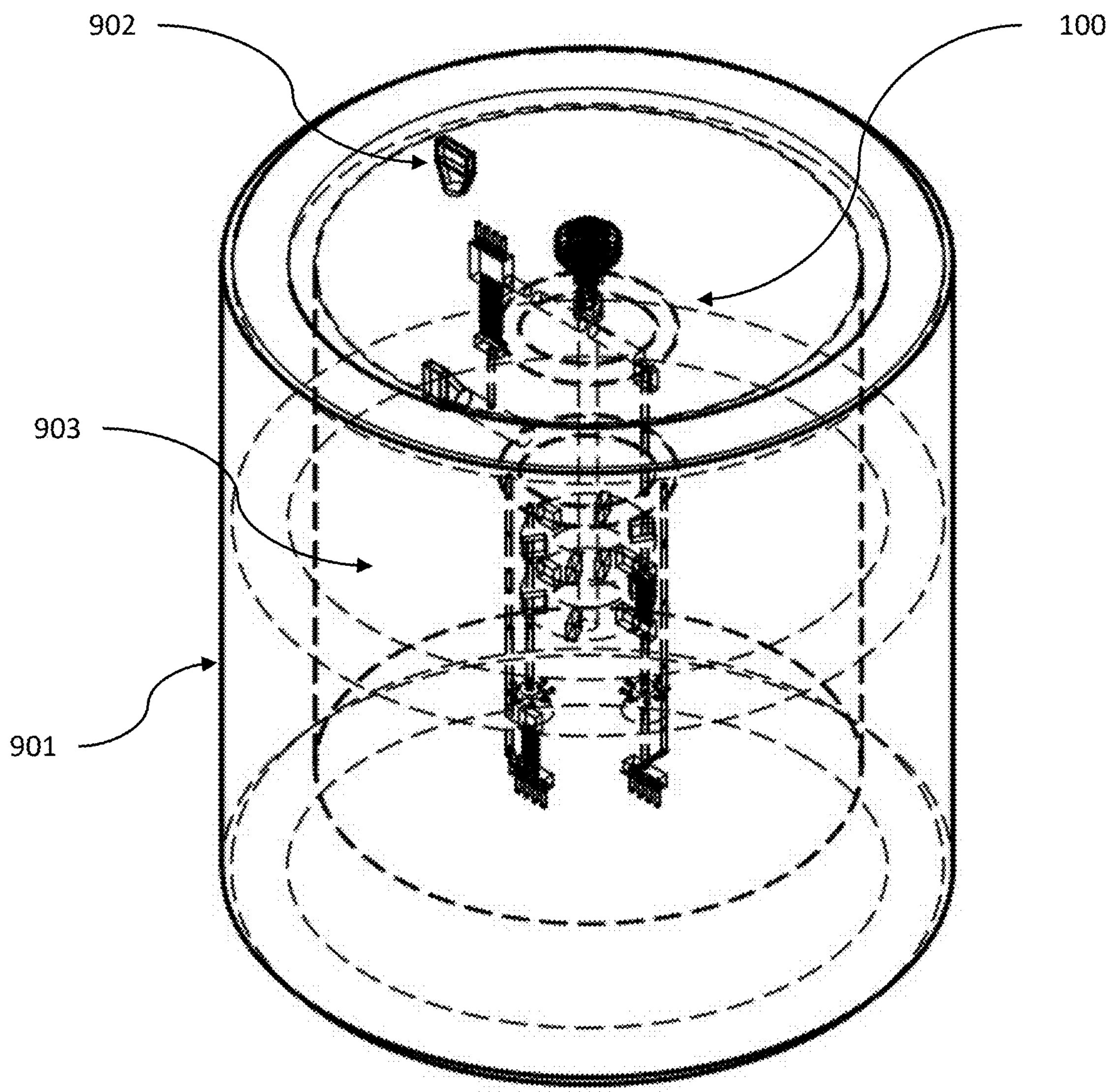


Fig. 9

SAMPLE ANALYSIS SYSTEM WITH PHASE-BASED TARGET IDENTIFICATION AND EXTRACTION

TECHNICAL FIELD

[0001] The present disclosure relates to remote and automated maintenance, processing, and recovery of sedimentary deposits in extreme environments.

BACKGROUND

[0002] The vast potential of renewable energy has driven the widespread adoption of photovoltaic (PV) solar panels. However, in extreme environments their efficient power generation can be impacted by the accumulation of windblown matter, including minerals, loess (fine-grained windblown sediment), solar wind deposits, and airborne chemicals. While seemingly inconsequential, these deposits can significantly reduce panel efficiency by obscuring sunlight and altering thermal properties. Moreover, the composition and behavior of this windblown matter are of significant scientific interest due to its diverse origins and environmental implications.

[0003] Understanding the presence of specific minerals and chemicals in windblown matter can indicate anthropogenic pollution sources, monitor the spread of harmful airborne contaminants, and contribute to understanding their impact on human health and ecosystems.

[0004] Studying windblown, sedimented or deposited matter provides valuable insight for understanding dust transport on other planets, moons, and space dusts shedding light on their geological history and potential for sustaining life. Windblown deposits sometimes contain rare or valuable minerals or living and non-living matter, leading to potential applications in mineral exploration and recovery. Additionally, loess deposits are often fertile soils supporting agriculture, forestry, space and other scientific explorations.

[0005] While windblown matter poses a challenge to solar panel efficiency, understanding its composition and deposition patterns can inform the development of improved panel designs and cleaning strategies, thereby optimizing PV energy production. Therefore, a comprehensive understanding of windblown matter and its impact on various fields necessitates efficient methods for its collection, detection, and analysis. Embodiments herein disclosed address the need by providing a novel device specifically designed to extract and purify windblown samples from PV solar panels or other collected mixed multiphases materials for further scientific exploration and practical applications.

SUMMARY

[0006] Embodiments of the present disclosure provide a system for analyzing a sample of material collected from the surface of a solar panel or other collections methods of deposited, sedimented, and rocky multiphasic matters and materials. Other sediments, deposits, and collected materials that contained mixed multiphases and matter states can be processed utilizing this technology. The system includes an analysis module that performs a cycle of operations, which includes selecting a phase analyte of the sample in a phase module, identifying a target product from the phase analyte in a component module, and extracting the target product from the phase analyte using one or more extraction modules. The system also includes a device that interfaces with the analysis module and includes a processor that activates one or more of the extraction modules during the cycle of operations. The one or more extraction modules are configured to reduce the phase analyte purity to a predetermined level during the cycle of operations.

[0007] In some aspects, the techniques described herein relate to a system for analysis of a sample including: an analysis module configured to perform a cycle of operations including: (a) selecting a phase analyte of the sample in a phase module, (b) identifying a target product from the phase analyte in a component module, and (c) extracting the target product from the phase analyte in one or more extraction modules; a device configured to interface with the analysis module and including a processor configured to activate one or more of extraction modules during a cycle of operations a)-c), wherein the one or more extraction modules are configured to reduce phase analyte purity to during the cycle of operations a)-c).

[0008] In some aspects, the techniques described herein relate to a system wherein the processor is configured to activate the component module, wherein the component module is configured to identify a chemical component of the target product.

[0009] In some aspects, the techniques described herein relate to a system wherein the component module includes a pressure gradient tube, and is configured to control transport of the chemical component from a collection chamber to a chemical identification component.

[0010] In some aspects, the techniques described herein relate to a system wherein the processor is configured to receive a feedback signal from the chemical identification component, and adjust the component module to control transport to a second chemical identification component based on the feedback signal.

[0011] In some aspects, the techniques described herein relate to a system wherein the processor is configured to activate the phase module, wherein the phase module is configured to identify a thermodynamic phase of the sample.

[0012] In some aspects, the techniques described herein relate to a system wherein the processor is configured to receive a feedback signal from the phase module and activate the one or more extraction modules based on the feedback signal.

[0013] In some aspects, the techniques described herein relate to a system wherein the processor is configured to receive a feedback signal from the analysis module and activate a recycling module configured to control transport of the target product to a storage component based on the feedback signal from the analysis module.

[0014] In some aspects, the techniques described herein relate to a system wherein the device further includes a photovoltaic cleaning module including a sensor used to determine whether the external plane of a photovoltaic panel has above a certain threshold of dust or other debris, a scrubber configured to move a across the external facing plane of a photovoltaic panel across one or more axis, a fluid delivery element located at the scrubber, and a sample collection element, wherein the sample collection element is configured to communicate with the analysis module to control the analysis of the sample (and a container to receive the sample) to be analyzed.

[0015] In some aspects, the techniques described herein relate to a system for remotely and automatically analyzing a mixed phase sample including: a distribution component including a spectrometer module, wherein the distribution component is configured to accommodate the mixed phase sample and configured to transmit a signal to a central processing unit, wherein the central processing unit is configured to send an operational signal to the distribution component based on the signal from the spectrometer module, wherein the distribution component is configured to transfer the mixed phase sample from a sample inlet to a filtration component based on the operational signal.

[0016] In some aspects, the techniques described herein relate to a system, wherein the filtration component is configured to communicate with a sample reservoir component configured to accommodate at a least a first portion of the mixed phase sample, the filtration component is configured to communicate with a separation column at least a second portion of the mixed phase sample.

[0017] In some aspects, the techniques described herein relate to a system, wherein the distribution component further includes an ultrasonic component configured to receive a feedback signal from the filtration component and activate an ultrasonic extraction module in the extraction based on the feedback signal from the filtration component.

[0018] In some aspects, the techniques described herein relate to a system, further including a purification module, wherein the feedback signal received by the central processing unit from the spectrometer module controls operation of the purification module which is configured to communicate with the sample reservoir component.

[0019] In some aspects, the techniques described herein relate to a system, wherein the distribution component further includes a rotatable selection component configured to communicate with the separation column further configured to produce a feedback signal, and based on the feedback signal from the separation column, a rotatable selection column selectively rotates a rotatable portion of the distribution component, wherein the second portion of the mixed phase sample is communicated from the separation column to the rotatable selection component.

[0020] In some aspects, the techniques described herein relate to a system, wherein the rotatable selection component further includes an analyzer, the analyzer being configured to isolate a specific component from the second portion of the mixed phase sample, and communicate the specific component to a second reservoir component.

[0021] In some aspects, the techniques described herein relate to a system, wherein the analyzer is further configured to communicate a remainder of the mixed phase sample to the filtration component via the distribution component further including a feedback loop configured to communicate the remainder of the mixed phase sample from the analyzer to the filtration component.

[0022] In some aspects, the techniques described herein relate to a method for purifying a mixed phase sample including: providing a central processing unit configured to communicate and control a distribution component including: a sample inlet, a spectrometer, and a filtration component, a sample reservoir, and a separation column; transferring the mixed phase sample from the sample inlet to the spectrometer; analyzing the mixed phase sample via the spectrometer; filtering and separating the mixed phase sample via the filtration component; and communicating a first portion of the mixed phase sample to the sample reservoir and second portion of the mixed phase sample to the separation column.

[0023] In some aspects, the techniques described herein relate to a method, further including: providing an ultrasonic component configured to receive a signal from the filtration component; and ultrasonically separating at least one component of the second portion of the mixed phase sample in the separation column.

[0024] In some aspects, the techniques described herein relate to a method, further including: providing a rotatable selection component configured to communicate with the separation column via a feedback signal, and configured to provide a first assay configured to extract a first target and a second assay configured to extract a second target, wherein the rotatable selection component is configured to communicate the mixed phase sample from the separation column to a second reservoir component; signaling the rotatable selection component based on the feedback signal from the separation column; rotating the rotatable selection component; selecting the first assay; extracting the first target; rotating the rotatable selection component; selecting the second assay; extracting the second target; and transferring the first and second targets to the second reservoir component.

[0025] In some aspects, the techniques described herein relate to a method, further including: providing a feedback module configured to communicate the first and second targets in the second reservoir component to the distribution component further including a target container and a feedback loop configured to communicate the second reservoir component with the spectrometer; transferring the first target from the second reservoir component to the target container; transferring the second target from the second reservoir component to the feedback loop; analyzing the second target via the spectrometer; filtering and separating the second target via the filtration component; and communicating a first portion of the second target to the sample reservoir, and a second portion of the second target to the separation column.

[0026] Embodiments include one, more, or any combination of the various apparatuses and methods described herein. Other features and advantages of the present disclosure will become apparent from the following more detailed description, taken in conjunction with the accompanying, which illustrate, by way of example, the principles of the disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027] FIG. **1** illustrates a perspective view of a Sample Analysis System, according to embodiments of the present disclosure.

[0028] FIG. **2** illustrates a flow diagram for a method of purifying a mixed phase sample, according to embodiments of the present disclosure.

[0029] FIG. **3** illustrates a perspective view of a Sample Analysis System according to embodiments of the present disclosure.

[0030] FIG. **4** illustrates a side elevation view of a Sample Analysis System according to embodiments of the present disclosure.

[0031] FIG. **5** illustrates a perspective view of a Sample Analysis System according to embodiments of the present disclosure.

[0032] FIG. **6** illustrates a side elevation view of a Sample Analysis System according to embodiments of the present disclosure.

[0033] FIG. 7 illustrates a perspective view of a Sample Analysis System according to embodiments of the present disclosure.

[0034] FIG. 8 illustrates a system for purifying a mixed phase sample according to embodiments of the present disclosure.

[0035] FIG. 9 illustrates a perspective view of a Sample Analysis System according to embodiments of the present disclosure.

[0036] Corresponding reference characters indicate corresponding parts throughout the several views.

[0037] While the disclosure is amendable to various modifications and alternative forms, specific embodiments have been shown by way of example in the drawings and are described in detail below. The intention, however, is not to limit the disclosure to the particular embodiments described. On the contrary, the disclosure is intended to cover all modifications, equivalents, and alternatives falling within the scope of the disclosure as defined by the appended claims.

DETAILED DESCRIPTION

[0038] The following detailed description illustrates embodiments of the disclosure and manners by which they can be implemented. Although the best mode of carrying out the present disclosure has been disclosed, those skilled in the art would recognize that other embodiments for carrying out or practicing the present disclosure are also possible.

[0039] It should be noted that the terms "first," "second," and the like, herein do not denote any order, quantity, or importance, but rather are used to distinguish one element from another. Further, the terms "a" and "an" herein do not denote a limitation of quantity, but rather denote the presence of at least one of the referenced item.

[0040] Purification and isolation of elements, materials and microorganisms in a bulk, windborne or otherwise on-site collected sample requires significant assay therefore, an automatically adaptable system is described herein. The automatically adaptable system is configured for the analysis of any sample regardless of the on-site sample selection technique, or properties of the sample. A chain process of identification, extraction, purification, and selection of appropriate assays affected by the measurements made by initial measurements of the system can accomplish purification and isolation of the sub-components of the sample.

[0041] As shown in FIGS. **1**-**7**, the techniques described herein relate to a system for analysis of a sample (SAS). The SAS **100** can comprise an analysis module **101** configured to perform a cycle of operations. The analysis module **101**, according some embodiments, is configured to accommodate a sample and isolate various thermodynamic phase of the sample, chemical structures, and properties thereof. The cycle of operations performed by the analysis module **101** can include: (a) selecting a phase analyte of the sample in a phase module **102**, (b) identifying a target product from the phase analyte in a component module **103**, and (c) extracting the target product from the phase analyte in one or more extraction modules **104**; a device **105** configured to interface with the analysis module **101** and including a processor configured to activate one or more of extraction modules **104** during a cycle of operations a)-c), wherein the one or more extraction modules **104** are configured to reduce phase analyte purity to between 85%-90% during the cycle of operations a)-c).

[0042] In some cases, according to embodiments of the present disclosure the analysis module **101** can include the following assays, includes, but it not limited to the following assays: Atomic Absorption Spectrometer, Atomic and Optical Emission Spectrometer, Benchtop NMR Spectrometers, Electrochemical Analysis, Electron paramagnetic resonance, Elemental Analyzers, Fluorescence Spectrometers, Fourier Transform Isotope Spectrometer, Fourier Transform Near-Infrared (FT-NIR) Spectrometers, Grabner flash point detection, Gas analyzers, Gas chromatograph, Gel Permeation Chromatography, Raman Analysis, X-Ray Fluorescence Analyzer, Hyperspectral imaging and sensing, Ion Chromatography, Mass Spectrometer, NMR spectroscopy Analyzer, Pharmaceutical Analysis Equipment, Secondary Ion Mass Spectrometry, Vapor Pressure Measurements, X-Ray and Gamma Ray Detectors, C-Ray Diffractometers, X-Ray Fluorescence Analyzers, X-ray Optics, X-Ray Photoelectron Spectroscopy, and XRF Spectrometer.

[0043] In some aspects, the techniques described herein relate to a SAS **100** that is capable of being integrated into a portable housing and connected to a photovoltaic solar array system. In some cases, the SAS **100** may be configured to operated remotely via connection with a wireless network. In some cases, the SAS **100** can be utilized to analyze particulate accumulated on the surface of a photovoltaic panel **703**.

[0044] In some aspects, the techniques described herein relate to a system wherein the processor is configured to activate the component module **103**, wherein the component module **103** is configured to identify a chemical component of the target product.

[0045] As shown in FIG. **6**, In some aspects, the techniques described herein relate to a SAS **100** wherein the component module **103** includes a pressure gradient tube **601**, and is configured to control transport of the chemical component from a collection chamber **602** to a first chemical identification component **603**. In some cases, the pressure gradient tube **601**, can comprise a peristaltic pump.

[0046] In some aspects, the techniques described herein relate to a SAS **100** wherein the processor is configured to receive a feedback signal from the first chemical identification component **603**, and adjust the component module **103** to control transport to a second chemical identification component **604** based on the feedback signal.

[0047] In some aspects, the techniques described herein relate to a SAS **100** wherein the processor is configured to activate the phase module **102**, wherein the phase module **102** is configured to identify a thermodynamic phase of the sample.

[0048] In some aspects, the techniques described herein relate to a SAS **100** wherein the processor is configured to receive a feedback signal from the phase module **102** and activate the one or more extraction modules **104** based on the feedback signal.

[0049] In some aspects, the techniques described herein relate to a SAS **100** wherein the processor is configured to receive a feedback signal from the analysis module and activate a recycling module configured to control transport of the target product to a storage component based on the feedback signal from the analysis module. In some case embodiment herein disclosed include a computing device system configured to communicate and transmit signals between various elements herein.

[0050] As shown in FIG. **7**, in some aspects, the techniques described herein relate to a SAS **100** wherein the device **105** further includes a photovoltaic cleaning module **701** including of a scrubber **702** configured to move a across a photovoltaic panel **703**, a fluid delivery element **704**, and a sample collection element **705**, wherein the sample collection element **705** is configured to communicate with the analysis module **101** to control the analysis of the sample.

[0051] In some cases, the SAS **100** is configured to couple with a photovoltaic panel **703** such that the SAS **100** is powered via an electrical component connection to a solar array. In some cases, the electrical component connection can comprise a voltage input which is configured to receive an output voltage from a solar array. In some cases, the solar array is at least one photovoltaic panel. The electrical component connection may further include a maximum power point tracking (MPPT) inverter, wherein the MPPT inverter can receive the output voltage from the solar array, whereby the MPPT inverter is also configure to deliver a solar voltage to a battery charger, a battery charge controller, and a battery bank.

[0052] In some cases, the battery charger is configured to communicate with the battery bank, wherein the battery charge controller is configured to deliver a charge profile to the battery bank based on a user input. The user input can comprise a set point voltage, float voltage, bulk charge voltage, and disconnect voltage. In some cases, the user input controls the delivery of power to the battery bank.

[0053] According to embodiments of the present disclosure, the battery bank can consist, but is not limited to: of LifePO4 batteries, Absorption Glass Matt (AGM) batteries, Lead-Acid batteries, Lithium-Ion batteries, and/or water-activated batteries.

[0054] According to embodiments of the present disclosure the battery bank deliver power to the SAS **100** to enable operation of the SAS **100**. In some embodiments, the battery bank can be configured to activate upon rainfall in the location of the photovoltaic panel **703**, whereby water collected from the surface of the photovoltaic panel **703** can activate the photovoltaic cleaning module **701**, via a precipitation sensor configured to measure relative humidity, temperature, and dewpoint and estimate precipitation total.

[0055] In some cases, the photovoltaic cleaning module **701** can be rain-activated, wherein the photovoltaic cleaning module **701** receives a signal from the precipitation sensor and then the cleaning module **701** sends a signal to the scrubber **702**, wherein the scrubber **702** moves across the surface of the photovoltaic panel **703** and delivers debris scrubbed off the surface of the photovoltaic panel **703** into the sample collection element **705**.

[0056] In some cases, the sample collection element **705** transmits debris collected via the scrubber **702** from the photovoltaic panel **703** to the SAS **100**, whereby the debris is analyzed using the SAS **100**.

[0057] As shown in FIGS. **1**, **3-6**, in some aspects, the techniques described herein relate to a SAS **100** for analyzing a mixed phase sample that can include a distribution component **301** which may be a distribution network of piping that can facilitate the movement of a sediment in-situ of a liquid, and/or gas sample provided to the sample inlet **300**. The first chemical identification component **603** may further include a spectrometer module **302**, wherein the distribution component **301** is configured to accommodate the mixed phase sample and configured to transmit a signal to a central processing unit, wherein the central processing unit is configured to send an operational signal to the distribution component **301** based on the signal from the spectrometer module **302**, wherein the distribution component **301** can be configured to transfer the mixed phase sample from a sample inlet **300** to a filtration component **401** based on the operational signal.

[0058] As shown in FIGS. **1** and **4** in some aspects, the techniques described herein relate to a SAS **100**, wherein the filtration component **401** is configured to communicate with a sample reservoir **402** component configured to accommodate at a least a first portion of the mixed phase sample, the filtration component **401** is configured to communicate with a separation column **403** at least a second portion of the mixed phase sample.

[0059] In some cases, the sample reservoir **402** can be configured to communicate with a rotatable selection component **405**, wherein the rotatable selection component **405** is configured to communicate with the central processing unit, based on a signal from the extraction module **104**, wherein the rotatable selection component **405** is configured to communicate with the sample reservoir having a phase-specific storage subcomponent, e.g., gas, liquid, and solid.

[0060] In some cases, the separation column **403** can be configured to communicate with a rotatable selection component **405**, wherein the rotatable selection component **405** is configured to communicate with the central processing unit, based on a signal from the extraction module **104**, wherein the rotatable selection component **405** is configured to communicate with the separation column **403** having a phase-specific separation subcomponent, e.g., gas, liquid, and solid.

[0061] In some aspects, as shown in FIG. **4** the techniques described herein relate to a SAS **100**, wherein the distribution component **301** further includes an ultrasonic component configured to receive a feedback signal from the filtration component **401** and activate an ultrasonic extraction module **404** based on the feedback signal from the filtration component **401**.

[0062] As shown in FIG. **5** in some aspects, the techniques described herein relate to SAS **100**, further including a purification module **501**, wherein the feedback signal received by the central processing unit from the spectrometer module **302** controls operation of the purification module **501** which is configured to communicate with the sample reservoir component.

[0063] As shown in FIGS. **1**, **3-6** in some aspects, the techniques described herein relate to a SAS **100**, wherein the distribution component **301** further includes a rotatable selection component **405** configured to communicate with the separation column **403** further configured to produce a feedback signal, and based on the feedback signal from the separation column **403**, a rotatable selection component **405** selectively rotates a rotatable portion of the analysis module **101**, wherein the second portion of the mixed phase sample is communicated from the separation column **403** to the rotatable selection component **405**.

[0064] In some cases, the rotatable selection component **405**, can be configured to include any of the assays included in the SAS **100**. The rotatable selection component **405** accommodates the ability of the SAS **100** to make measurements of the mixed phase sample and identify the chemical components and physical properties thereof.

[0065] As shown in FIG. **5** in some aspects, the techniques described herein relate to a SAS **100**, wherein the rotatable selection component **405** further includes an analyzer **502**, the analyzer **502** being configured to isolate a specific component from the second portion of the mixed phase sample, and communicate the specific component to a second reservoir component **503**.

[0066] In some aspect, the rotatable selection component **405** further includes a gravitational force factor. Various aspects of the rotatable selection component, including but not limited to, the analyzer **502**, can be configured to be rotated at a pre-determined velocity. This predetermined velocity can be selected by a user, or the output of the central processing unit, such that the rotatable selection component is configured to, separate materials phases of the mixed phase sample.

[0067] In some aspects, the techniques described herein relate to a SAS **100**, wherein the analyzer **502** is further configured to communicate a remainder of the mixed phase sample to the filtration component via the distribution component **301** further including a feedback loop **304** configured to communicate the remainder of the mixed phase sample from the analyzer **502** to the filtration component.

[0068] As shown in FIG. **2** in some aspects, the techniques described herein relate to a Method for purifying a mixed phase sample including: providing a central processing unit configured to communicate and control a distribution component **301** including: a sample inlet **300**, a spectrometer module **302**, and a filtration component **401**, a sample reservoir **402**, and a separation column **403**; transferring the mixed phase sample from the sample inlet **300** to the spectrometer module **302**; analyzing the mixed phase sample via the spectrometer module **302**; filtering and separating the mixed phase sample via the filtration component **401**; and communicating a first portion of the mixed phase sample to the sample reservoir **402** and second portion of the mixed phase sample to the separation column **403**.

[0069] In some aspects, the techniques described herein relate to a method, further including: providing an ultrasonic extraction module **404** configured to receive a signal from the filtration component **401**; and ultrasonically separating at least one component of the second portion of the mixed phase sample in the separation column **403**.

[0070] In some aspects, as shown in FIG. **2**, the techniques described herein relate to a method, further including: providing a rotatable selection component **405** configured to communicate with the separation column **403** via a feedback signal, and configured to provide a first assay configured to extract a first target and a second assay configured to extract a second target, wherein the rotatable selection component **405** is configured to communicate the mixed phase sample from the separation column **403** to a second reservoir component **503**; signaling the rotatable selection component **405** based on the feedback signal from the separation column **403**; rotating the rotatable selection component **405**; selecting the first assay; extracting the first target; rotating the rotatable selection component **405**; selecting the second assay; extracting the second target; and transferring the first and second targets to the second reservoir component **503**.

[0071] In some aspects, the techniques described herein relate to a method, further including: providing a feedback module configured to communicate the first and second targets in the second reservoir component **503** to the distribution component **301** further including a target container **406** and a feedback loop **304** configured to communicate the second reservoir component **503** with the spectrometer module **302**; transferring the first target from the second reservoir component **503** to the target container **406**; transferring the second target from the second reservoir component **503** to the feedback loop via the distribution component **301**; analyzing the second target via the spectrometer module **302**; filtering and separating the second target via the filtration component **401**; and communicating a first portion of the second target to the sample reservoir **402**, and a second portion of the second target to the separation column **403**.

[0072] FIG. **8** illustrates one example of a computing device system **800**, configured in accordance with one or more embodiments. According to various embodiments, a computing device system **800** suitable for implementing embodiments described herein includes a processor **801**, a memory module **803**, a storage device **805**, an interface **811**, and a bus **815** (e.g., a PCI bus or other interconnection fabric.) Computing device system **800** may operate as variety of devices such as an application server, a database server, or any other device or service described herein. Although a particular configuration is described, a variety of alternative configurations are possible. The processor **801** may perform operations such as those described herein. Instructions for performing such operations may be embodied in the memory bank **803**, on one or more non-transitory computer readable media, or on some other storage device. Various specially configured devices can also be used in place of or in addition to the processor **801**. The interface **811** may be configured to send and receive data packets over a network. Examples of supported network interfaces include, but are not limited to: Ethernet, fast Ethernet, Gigabit Ethernet, frame relay, cable, digital subscriber line (DSL), token ring, Asynchronous Transfer Mode (ATM), High-Speed Serial Interface (HSSI), and Fiber Distributed Data Interface (FDDI). These interfaces may include ports appropriate for communication with the appropriate media. They may also include an independent processor and/or volatile RAM. A computer system or computing device may include or communicate with a monitor, printer, or other suitable display for providing any of the results mentioned herein to a user.

[0073] According to some embodiments, the SAS **100** may be configured to record a time variable associated with the collection of samples. In some cases, the SAS **100** may use a computing device system to communicate and record a location variable, time variable, and weather variables such as humidity, windspeed, and atmospheric pressure. In some cases, the SAS **100** and the computing device system are configured to communicate with a laser engraving mechanism enabled to engrave a Quick Response (QR) code onto a surface of at least the sample reservoir **402**, and or the second reservoir component **503**.

[0074] FIG. **9** Illustrates a housing **901** configured to enclose the SAS **100**, according to some embodiments. In some cases, the SAS **100** can be configured for the temperature control and pressure control via the housing **901** and the computing device system **800**. In some cases, the housing **901** can include an external pressure control element **902** configured to regulate pressure between an interior of the housing **901** and the exterior. In some cases, the housing **901** can be configured to thermodynamically insulate the interior **903** of the housing **901** from the exterior. In some cases, the housing **901** is configured to enable the SAS **100** for rotational movement so that the housing **901** can generate rotational gravity forces creating a microgravity environment.

[0075] The examples mentioned above are merely used for illustrative purposes and not meant to be limitations of the present disclosure. Furthermore, the approaches in various embodiments of the present disclosure are implemented according to the universal conversion method and related circuitry provided by the embodiments of the present disclosure.

What is claimed is:

1) A system for automatically and remotely collecting and analyzing one or more mixed phase samples over time comprising:

an analysis module comprising a phase module comprising a Raman spectrometer; configured to perform a cycle of operations comprising:

a) Selecting a phase analyte of the sample in the phase module,

b) Identifying a target product from the phase analyte in a component module comprising a gas chromatograph, and

c) Extracting the target product from the phase analyte in one or more extraction modules comprising a gel permeation chromatograph;

a device configured to interface with the analysis module and comprising a processor configured to activate one or more of extraction modules during a cycle of operations a)-c),

wherein the one or more extraction modules are configured to reduce phase analyte purity to 85% during the cycle of operations a)-c).

2) The system of claim **1**, wherein the processor is configured to activate the component module, wherein the component module is configured to identify a chemical component of the target product.

3) The system of claim **2**, wherein the component module comprises a distribution component comprising a pressure gradient tube, and is configured to control transport of the chemical component from a collection chamber to a chemical identification component.

4) The system of claim **3** wherein the processor is configured to receive a feedback signal from the chemical identification component, and adjust the component module to control transport to a second chemical identification component based on the feedback signal.

5) The system of claim **1** wherein the processor is configured to activate the phase module, wherein the phase module configured to identify a thermodynamic phase of the sample.

6) The system of claim **5** wherein the processor is configured to receive a feedback signal from the phase module and activate the one or more extraction modules based on the feedback signal.

7) The system of claim **1** wherein the processor is configured to receive a feedback signal from the analysis module and activate a recycling module configured to control transport of the target product to a storage component based on the feedback signal from the analysis module.

8) The system of claim **7** wherein the device further includes a photovoltaic cleaning module comprising of a scrubber configured to move across an external plane of a photovoltaic panel along one or more axes, a fluid delivery element configured to deliver a fluid to the photovoltaic panel, and a sample collection element configured to collect one or more samples, wherein the sample collection element is configured to receive the one or more samples and communicate with the analysis module to control the analysis of the one or more samples.

9) A system for automatically and remotely analyzing a mixed phase sample comprising:

a distribution component comprising a spectrometer module, wherein the distribution component is configured to accommodate a mixed phase sample inlet and configured to transmit a signal to a central processing unit, wherein the central processing unit is configured to send an operational signal to the distribution component based on the signal from the spectrometer module, wherein the distribution component is configured to transfer the mixed phase sample from a sample inlet to a filtration component based on the operational signal.

10) The system of claim **9**, wherein the filtration component is configured to communicate with a sample reservoir component configured to accommodate at a least a first portion of the mixed phase sample, the filtration component is configured to communicate with a separation column at least a second portion of the mixed phase sample.

11) The system of claim **10**, wherein the distribution component further comprises an ultrasonic component configured to receive a feedback signal from the filtration component and activate an ultrasonic extraction module based on the feedback signal from the filtration component.

12) The system of claim **11**, further comprising a purification module, wherein the feedback signal received by the central processing unit from the spectrometer module controls operation of the purification module which is configured to communicate with the sample reservoir component.

13) The system of claim **12**, wherein the distribution component further comprises a rotatable selection component configured to communicate with the separation column further configured to produce a feedback signal, and based on the feedback signal from the separation column, a rotatable selection column selectively rotates a rotatable portion of the distribution component, wherein the second portion of the mixed phase sample is communicated from the separation column to the rotatable selection component.

14) The system of claim **13**, wherein the rotatable selection component further comprises an analyzer, the analyzer being configured to isolate a specific component from the second portion of the mixed phase sample, and communicate the specific component to a second reservoir component.

15) The system of claim **14**, wherein the analyzer is further configured to communicate a remainder of the mixed phase sample to the filtration component via the distribution component further comprising a feedback loop configured to communicate the remainder of the mixed phase sample from the analyzer to the filtration component.

16) A method for remotely and automatically purifying a mixed phase sample comprising:

providing a central processing unit configured to communicate and control a distribution component comprising: a sample inlet, a spectrometer, and a filtration component, a sample reservoir, and a separation column;

transferring the mixed phase sample from the sample inlet to the spectrometer;

analyzing the mixed phase sample via the spectrometer;

filtering and separating the mixed phase sample via the filtration component; and

communicating a first portion of the mixed phase sample to the sample reservoir and second portion of the mixed phase sample to the separation column.

17) The method of claim **16**, further comprising:

providing an ultrasonic component configured to receive a signal from the filtration component; and

ultrasonically separating at least one component of the second portion of the mixed phase sample in the separation column.

18) The method of claim **17**, further comprising:

providing a rotatable selection component configured to communicate with the separation column via a feedback signal, and configured to provide a first assay configured to extract a first target and a second assay configured to extract a second target, wherein the rotatable selection component is configured to communicate the mixed phase sample from the separation column to a second reservoir component;

signaling the rotatable selection component based on the feedback signal from the separation column;

rotating the rotatable selection component;

selecting the first assay;

extracting the first target;

rotating the rotatable selection component;

selecting the second assay;

extracting the second target; and

transferring the first and second targets to the second reservoir component.

19) The method of claim **18**, further comprising:

providing a feedback module configured to communicate the first and second targets in the second reservoir component to the distribution component further comprising a target container and a feedback loop configured to communicate the second reservoir component with the spectrometer;

transferring the first target from the second reservoir component to the target container;

transferring the second target from the second reservoir component to the feedback loop;

analyzing the second target via the spectrometer;

filtering and separating the second target via the filtration component; and

communicating a first portion of the second target to the sample reservoir, and a second portion of the second target to the separation column.

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