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APPARATUS AND METHOD FOR PREVENTING MOLD GROWTH

Abstract

An apparatus, a method, and an insulated module to control mold growth is provided. The apparatus includes an enclosing structure defining a chamber therewithin to receive an insulation layer, a projection array comprising projections extending within the insulation layer, a heating element mechanically coupled with the enclosing structure to generate heat to cause the enclosing structure to conduct heat to the insulation layer, and a controller communicatively coupled with humidity sensor and the heating element. The enclosing structure is made of a heat conductive element. At least some of the projections are configured to host the humidity sensor to measure humidity data of the insulation layer. The controller is configured to generate a control signal to trigger the heating element based on a comparison between the humidity data and a humidity threshold.

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Background/Summary

TECHNICAL FIELD

[0001] The present invention relates generally to preventing mold growth, and more particularly the present invention relates to an apparatus and a method to prevent mold growth within an insulation material.

BACKGROUND

[0002] Walls are fundamental components of the building structures, providing essential support and defining a boundary between indoor and outdoor spaces. Traditionally, walls have been constructed using various materials, such as stone, wood and concrete. In recent years, insulation materials or gaps are added between an exterior and an interior face of walls to enhance insulation to regulate indoor temperature and energy efficiency.

[0003] Mold growth in walls and interior spaces of buildings is a persistent issue that affects the health of occupants and the integrity of the structure itself. Traditional methods of mold control often rely on reactive measures, such as chemical treatments or remediation after the mold has already established itself. These approaches can be costly, time-consuming, and may only offer temporary relief.

[0004] Therefore, there is a need to overcome drawbacks associated with the conventional methods of handling mold growth in walls.

SUMMARY

[0005] The present disclosure provides an apparatus and a method for preventing mold growth within the walls.

[0006] In one aspect, an apparatus for preventing mold growth is disclosed. The apparatus comprises an enclosing structure. The enclosing structure defines a chamber therewithin to receive an insulation layer. The enclosing structure is made of a heat conductive element. Further, the apparatus comprises a projection array arranged in association with the insulation layer. The projection array comprises a plurality of projections extending within the insulation layer. Moreover, at least some of the plurality of projections are configured to host a humidity sensor to measure humidity data of the insulation layer. The apparatus further comprises a heating element mechanically coupled with the enclosing structure. The heating element is configured to generate heat to cause the enclosing structure to conduct heat to the insulation layer. The apparatus further comprises a controller communicatively coupled with the humidity sensor and the heating element. The controller is configured to generate a control signal to trigger the heating element based on a comparison between the humidity data and a humidity threshold.

[0007] According to some embodiments, a plurality of projection arrays is arranged within the insulation layer.

[0008] According to some embodiments, the plurality of projections of the projection array extends perpendicularly from a surface of at least one of: a first side, or a second side opposite to the first side, of the projection array within the insulation layer.

[0009] According to some embodiments, the heating process comprises at least one of: activating the heating element, adjusting one or more vents, adjusting a humidity condition for the insulation layer, and deactivating the heating element when a cut-off is reached.

[0010] According to some embodiments, one or more projections of the plurality of projections are in connection with the heating element, and wherein the heating element conducts heat to the insulation layer through the one or more projections during the heating process.

[0011] According to some embodiments, each of the plurality of projections includes an outlet for hosting at least one of: the humidity sensor, a temperature sensor, a heating element, or a vent for heat distribution.

[0012] According to some embodiments, the insulation layer includes a plurality of regions, and wherein each of the plurality of regions includes at least one projection hosting the humidity sensor, at least one projection in connection with the heating element, and at least one projection hosting a temperature sensor.

[0013] According to some embodiments, the controller is further configured to detect a humidity condition for each of the plurality of regions of the insulation layer based on the corresponding humidity data and the humidity threshold. Further the controller is configured to transmit a control signal to the at least one projection in connection with heating element associated with at least one region to initiate the heating process based on detecting the humidity condition for the at least one region from the plurality of regions to be prone to mold growth.

[0014] According to some embodiments, the controller is remotely connected to a user device. The controller is configured to receive a control input from the user device, generate a temperature control signal for the heating element based on the control input, and transmit the temperature control signal to the heating element to initiate a temperature control. The control input is associated with the temperature control of the insulation layer.

[0015] According to some embodiments, the controller is configured to continuously retrieve real-time humidity data after initiating the heating process, determine whether current real-time humidity data from the continuously retrieved real-time humidity data is less than or substantially equal to a cut-off humidity threshold, and generate a control signal for deactivating the heating element based on the determination.

[0016] According to some embodiments, one or more projections of the plurality of projections are provided with a temperature sensor to measure temperature data associated with the insulation layer.

[0017] According to some embodiments, the enclosing structure is made of iron mesh.

[0018] According to some embodiments, the enclosing structure is used to enclose the insulation layer inside a wall of a building.

[0019] In another aspect, an insulated wall structure is disclosed. The insulated wall structure comprises an enclosing structure defining a chamber therewithin to receive an insulation layer. The enclosing structure is made of a heat conductive element. The insulated wall structure comprises a projection array arranged in association with the insulation layer. The projection array comprises a plurality of projections extending within the insulation layer. At least some of the plurality of projections are configured to host a humidity sensor to measure humidity data of the insulation layer. The insulated wall structure comprises a heating element mechanically coupled with the enclosing structure, and a controller communicatively coupled with the humidity sensor and the heating element. The heating element is configured to generate heat to cause the enclosing structure to conduct heat to the insulation layer. The controller is configured to generate a control signal to trigger the heating element based on a comparison between the humidity data and a humidity threshold.

[0020] In yet another aspect, a method for preventing mold growth is disclosed. The method is implemented using an apparatus comprising an enclosing structure defining a chamber therewithin to receive an insulation layer, wherein the enclosing structure is made of a heat conductive element. The apparatus comprises a projection array arranged in association with the insulation layer. The projection array comprises a plurality of projections extending within the insulation layer. Moreover, at least some of the plurality of projections are configured to host a humidity sensor to measure humidity data of the insulation layer. The apparatus comprises a heating element mechanically coupled with the enclosing structure, and a controller communicatively coupled with the humidity sensor and the heating element. The heating element is configured to generate heat to cause the enclosing structure to conduct heat to the insulation layer. The method comprises iteratively retrieving the humidity data; detecting humidity condition for the insulation layer based on the humidity data and a humidity threshold; and generating and transmitting a control signal to the heating element to initiate a heating process based on detecting the humidity condition to be prone to mold growth.

[0021] The foregoing summary is illustrative only and is not intended to be in any way limiting. In addition to the illustrative aspects, embodiments, and features described above, further aspects, embodiments, and features will become apparent by reference to the drawings and the following detailed description.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0022] Having thus described example embodiments of the disclosure in general terms, reference will now be made to the accompanying drawings, which are not necessarily drawn to scale, and wherein:

[0023] FIG. **1** is a block diagram of an exemplary network environment in which an apparatus for preventing mold growth is implemented, according to some embodiments;

[0024] FIG. **2** illustrates a block diagram of a controller of the apparatus, according to some embodiments;

[0025] FIG. **3** illustrates a flowchart of an exemplary method for preventing the mold growth, according to some embodiments;

[0026] FIG. **4**A illustrates an exemplary diagram of a wall structure for receiving an insulated module, according to some embodiments;

[0027] FIG. **4**B illustrates an exemplary diagram of the insulated module according to the present disclosure fitted within the wall structure, according to some embodiments;

[0028] FIG. **5**A illustrates an exemplary schematic diagram of an enclosing structure, according to some embodiments;

[0029] FIG. **5**B illustrates an exemplary schematic diagram of a projection array, according to some embodiments;

[0030] FIG. **5**C illustrates an exemplary schematic diagram of the enclosing structure housing the projection array, according to some embodiments; and

[0031] FIG. **6** illustrates a flowchart of a method for preventing mold growth, according to some embodiments.

DETAILED DESCRIPTION

[0032] In the following description, for purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of the present disclosure. It will be apparent, however, to one skilled in the art that the present disclosure may be practiced without these specific details. In other instances, systems and methods are shown in block diagram form only in order to avoid obscuring the present disclosure.

[0033] Reference in this specification to “one embodiment” or “an embodiment” means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the present disclosure. The appearance of the phrase “in one embodiment” in various places in the specification are not necessarily all referring to the same embodiment, nor are separate or alternative embodiments mutually exclusive of other embodiments. 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 items. Moreover, various features are described which may be exhibited by some embodiments and not by others. Similarly, various requirements are described which may be requirements for some embodiments but not for other embodiments.

[0034] Some embodiments of the present disclosure will now be described more fully hereinafter with reference to the accompanying drawings, in which some, but not all, embodiments of the disclosure are shown. Indeed, various embodiments of the disclosure may be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will satisfy applicable legal requirements. Like reference numerals refer to like elements throughout. Also, reference in this specification to “one embodiment” or “an embodiment” means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the present disclosure. The appearance of the phrase “in one embodiment” in various places in the specification are not necessarily all referring to the same embodiment, nor are separate or alternative embodiments mutually exclusive of other embodiments. 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 items. Moreover, various features are described which may be exhibited by some embodiments and not by others. Similarly, various requirements are described which may be requirements for some embodiments but not for other embodiments.

[0035] The embodiments are described herein for illustrative purposes and are subject to many variations. It is understood that various omissions and substitutions of equivalents are contemplated as circumstances may suggest or render expedient but are intended to cover the application or implementation without departing from the spirit or the scope of the present disclosure. Further, it is to be understood that the phraseology and terminology employed herein are for the purpose of the description and should not be regarded as limiting. Any heading utilized within this description is for convenience only and has no legal or limiting effect. Turning now to FIG. **1**-FIG. **6**, a brief description concerning the various components of the present disclosure will now be briefly discussed. Reference will be made to the figures showing various embodiments of a system for providing a user with an interactive map.

[0036] Wall serves as integral component of building structures, defining spaces, providing support, and contributing to overall stability. Over time, construction methods have evolved, introducing various materials and technologies to enhance wall functionalities. To provide the insulation from the outdoor environment integration of insulation materials within a wall structure has become a prominent strategy. The insulation material may be provided within a gap between an interior surface and an exterior surface of the wall structure. The insulation material may include, for example, insulation foam, which plays an important role in regulating temperature and reducing energy consumption. The insulation material, commonly made of expanded polystyrene or polyurethane foam, acts as a thermal barrier, preventing heat transfer and contributing to improved insulation performance and energy efficiency of heating and/or cooling systems of buildings.

[0037] Despite the benefits of insulation materials, they are susceptible to mold growth due to moisture infiltration. For example, damp environment within the insulation material that may arise during rainy seasons, flooding, bad plumbing in the house, etc., may become suitable for mold growth within the insulation material. The mold growth can have detrimental effects on both structural integrity of the building and human health.

[0038] Conventionally, methods for addressing mold growth include individuals resorting to post-detection solutions, such as using chemical agents like fungicides or applying antimicrobial treatments on surfaces where mold is visibly present. Physical removal, such as scrubbing or sanding, is another common approach. However, these conventional methods tend to be labor-intensive, time-consuming, and may only provide a temporary solution, as they do not address the root cause of mold formation.

[0039] Embodiments of present disclosure provide techniques for inhibiting mold growth within an insulation material of walls. Recognizing the prevalent challenge of mold proliferation in humid environments, the techniques described in the present disclosure provide a multifaceted approach for mold growth prevention. According to the present disclosure, an apparatus for preventing mold growth is provided. The apparatus is capable of dynamically monitoring, detecting, and proactively addressing environmental conditions that may lead to mold growth within an insulation material. In this manner, by continuously monitoring environmental conditions, the apparatus may detect and address mold-friendly conditions before visible growth occurs, preventing the need for extensive remediation. The apparatus may be integrated seamlessly into existing construction and building maintenance frameworks, providing an efficient and sustainable approach to mold prevention.

[0040] The proactive approach reduces the need for costly remediation efforts, saving building owners and occupants both time and money. In addition, by creating a healthier indoor environment by preventing mold growth, the apparatus contributes to improved occupant health and wellbeing. Further, the targeted interventions and proactive approach of the apparatus aligns with sustainability goals by minimizing the use of harmful chemicals and reducing the environmental impact associated with mold remediation.

[0041] FIG. **1** is a block diagram of an exemplary network environment **100** in which an apparatus **102** for preventing mold growth is implemented, according to some embodiments. The apparatus **102** includes an enclosing structure **104**, a projection array **108**, a heating element **110** and a controller **112**.

[0042] The enclosing structure **104** refers to a physical framework or a structure, providing the necessary containment for an insulation layer **106**. In an example, the enclosing structure **104** may accommodate and secure the insulation layer **106** within the walls of a building. The enclosing structure **104** along with the insulation layer **106** may provide thermal insulation, which helps regulate the temperature inside the building and improve energy efficiency. The enclosing structure **104** is made of a heat conductive element. Examples of the heat conductive element may include, but are not limited to, iron, steel, etc. For example, the enclosing structure **104** defines a chamber therewithin to receive the insulation layer **106**.

[0043] The insulation layer **106** placed within the walls of the building may enhance the energy efficiency, comfort, and longevity of the building. For example, the insulation layer **106** may address thermal requirements, and acoustic requirements to create more sustainable and resilient built environments. Insulation in buildings serves several important purposes, primarily related to enhancing energy efficiency, maintaining thermal comfort, and contributing to overall building performance.

[0044] The apparatus **102** includes the projection array **108**. For example, the projection array **108** is arranged in association with the insulation layer **106**. Moreover, the projection array **108** includes a plurality of projections that extend within the insulation layer **106**. Further, at least some of the plurality of projections of the projection array **108** are configured to host a humidity sensor to measure humidity data of the insulation layer **106**. In an example, each of the projections may include an outlet, such as a power outlet. These power outlet may be used to host a humidity sensor, a temperature sensor, a heating element, or a vent for heat distribution. For example, at least some, such as two or more projections may host humidity sensor to collect humidity data of different regions of the insulation layer **106**. Such regions may correspond to a surface area or an area within the insulation layer **106**. In an example, one or more humidity sensors may be positioned along a length of the projections to enable the humidity sensors to reach the different regions, such as the surface areas, and areas of different depths within the insulation layer **106**.

[0045] The apparatus **102** includes the heating element **110**. The heating element **110** is mechanically coupled with the heat-conductive enclosing structure **104**. The heating element **110** is configured to generate heat to cause the enclosing structure **104** to conduct heat to the insulation layer **106**. In an example, the heating element is a material or device that converts electrical energy into heat or thermal energy. For example, the heating element **110** is supplied with a power source.

[0046] The apparatus **102** further includes the controller **112** communicatively coupled with the humidity sensor and the heating element **110**. The controller **112** is configured to generate a control signal to trigger the heating element **110** based on a comparison between the humidity data and a humidity threshold. In an example, the humidity data may indicate a percentage or a score indicating a humidity level within an area where the corresponding humidity sensor and corresponding projection is located within or on the surface of the insulation layer **106**. Based on a comparison between the humidity data and the humidity threshold, a determination is made whether the area for which the humidity data is compared is prone to mold growth or not. For example, if the humidity data or the detected humidity level corresponding to a region of the insulation layer **106** is greater than the humidity threshold, the controller **112** is configured to trigger the heating process. To trigger the heating process, the controller **112** is configured to generate a control signal to trigger the heating element **110**. Since the heating element **110** is connected to the enclosing structure **104**, the heat emitted by the heating element **110** is transferred or conducted to the enclosing structure **104**. Further, the enclosing structure **104** along with the heating element **110** may heat the insulation layer **106** from different sides of the enclosing structure **104**.

[0047] In an example, the controller **112** is connected with the humidity sensor and the heating element **110** using a communication network. The communication network may be wired, wireless, or any combination of wired and wireless communication networks, such as cellular, Wi-Fi, internet, local area networks, or the like. In some embodiments, the communication network may include one or more networks such as a data network, a wireless network, a telephony network, or any combination thereof. It is contemplated that the data network may be any local area network (LAN), metropolitan area network (MAN), wide area network (WAN), a public data network (e.g., the Internet), short range wireless network, or any other suitable packet-switched network, such as a commercially owned, proprietary packet-switched network, e.g., a proprietary cable or fiber-optic network, and the like, or any combination thereof. In addition, the wireless network may be, for example, a cellular network and may employ various technologies including enhanced data rates for global evolution (EDGE), general packet radio service (GPRS), global system for mobile communications (GSM), Internet protocol multimedia subsystem (IMS), universal mobile telecommunications system (UMTS), etc., as well as any other suitable wireless medium, e.g., worldwide interoperability for microwave access (WiMAX), Long Term Evolution (LTE) networks (for e.g. LTE-Advanced Pro), 5G New Radio networks, ITU-IMT 2020 networks, code division multiple access (CDMA), wideband code division multiple access (WCDMA), wireless fidelity (Wi-Fi), wireless LAN (WLAN), Bluetooth, Internet Protocol (IP) data casting, satellite, mobile ad-hoc network (MANET), and the like, or any combination thereof.

[0048] FIG. **2** illustrates a block diagram of the controller **112** of the apparatus **102**, according to some embodiments. FIG. **2** is explained in conjunction with elements from FIG. **1**. The controller **112** may include a processor **202**, a memory **204**, a communication interface **206**, and an I/O interface **208**. The processor **202** may be communicatively coupled to the memory **204**, the communication interface **206**, and the I/O interface **208**.

[0049] The controller **112** may be a hardware device, a software program, or a combination thereof. The controller **112** is configured to manage or direct the flow of data between two entities. In an example, the controller **112** may be cards, microchips, or separate hardware devices for the control of a peripheral device, such as the heating element **110** and the humidity sensors of the projection array **108**.

[0050] For example, the processor **202** may be embodied as one or more of various hardware processing means such as a coprocessor, a microprocessor, a controller, a digital signal processor (DSP), a processing element with or without an accompanying DSP, or various other processing circuitry including integrated circuits such as, for example, an ASIC (application specific integrated circuit), an FPGA (field programmable gate array), a microcontroller unit (MCU), a hardware accelerator, a special-purpose computer chip, or the like. As such, in some embodiments, the processor **202** may include one or more processing cores configured to perform independently. A multi-core processor may enable multiprocessing within a single physical package. Additionally or alternatively, the processor **202** may include one or more processors configured in tandem via the bus to enable independent execution of instructions, pipelining and/or multithreading. Additionally, or alternatively, the processor **202** may include one or more processors capable of processing large volumes of workloads and operations to provide support for big data analysis. In an example embodiment, the processor **202** may be in communication with the other components of the controller **112** via a bus or the communication interface for passing information among components of the controller **112**.

[0051] In an example, when the processor **202** is embodied as an executor of software instructions, the instructions may specifically configure the processor **202** to perform the algorithms and/or operations described herein when the instructions are executed. Pursuant to embodiments of present disclosure, the processor **202** of the controller **112** may implement or execute instructions to perform operations of the system **102** and/or the estimation model **104**. However, in some cases, the processor **202** may be a processor specific device (for example, a mobile terminal or a fixed computing device) configured to employ an embodiment of the present disclosure by further configuration of the processors by instructions for performing the algorithms and/or operations described herein. The processor **202** may include, among other things, a clock, an arithmetic logic unit (ALU) and logic gates configured to support operation of the processor **202**. In an example, the processor **202** includes an input module **202**A, a comparison module **202**B, and an output module **202**C.

[0052] For example, the input module **202**A is configured to receive, retrieve, obtain, or access input data. In an example, the input module **202**A may utilize the communication interface **206** to obtain the input data. In an example, the input data may include sensor data, such as humidity data **204**A, and temperature data **204**B. The communication interface **206** may be wired, wireless, or any combination of wired and wireless communication networks, such as cellular, wireless fidelity (Wi-Fi), internet, local area networks, or the like.

[0053] The I/O interface **208** may include circuitry and/or software that may be configured to provide an output, such as transfer control signals to the heating element **110** for triggering the heating process, and receive, measure, or sense the input sensor data.

[0054] Further, the memory **204** may be non-transitory and may include, for example, one or more volatile and/or non-volatile memories. In other words, for example, the memory **204** may be an electronic storage device (for example, a computer readable storage medium) comprising gates configured to store data (for example, bits) that may be retrievable by a machine (for example, the processor **202** of the controller **112**). The memory **204** may be configured to store information, data, content, applications, instructions, or the like, for enabling the processor **202** of the controller **112** to conduct various functions in accordance with an example embodiment of the present disclosure.

[0055] As may be understood, the projection array **108** may have projections hosting sensors. In an example, an equal number or substantially equal number of projections may be provided at each of a pair of opposite sides of a substrate of the projection array **108**. In other words, a set of projections are provided at a first side of the substrate facing one side of the insulation layer **106**, and another set of projections are provided at a second side of the substrate facing another side of the insulation layer **106**. The set of projections are in contact with a surface of the insulation layer **106** and/or a region within the insulation layer **106**.

[0056] For example, some of the projections of the plurality of projections of the projection array **108** may host humidity sensors, and other projections may host temperature sensors. In an embodiment, certain projections in the projection array **108** may also host a heating element or a heat-conductive device that may be connected to the heating element **110** to transfer or conduct heat. In another embodiment, certain projections in the projection array **108** may also host vents that is configured to ensure proper distribution of the heat conducted by the heating element **110**, the enclosing structure **104** and/or the heating element in the projections within the insulation layer **106**. To this end, the humidity sensors may measure or sense humidity data **204**A associated with different regions of the insulation layer **106**. Similarly, the temperature sensors may measure, or sense temperature data associated with the different regions of the insulation layer **106**. In this manner, humidity data **204**A and temperature data **204**B for the insulation layer **106** are measured.

[0057] In operation, the input module **202**A is configured to obtain, retrieve, or receive the humidity data **204**A and the temperature data **204**B associated with the insulation layer **106**. In an example, the input module **202**A is connected to the humidity sensors and the temperature sensors provided at the projections of the projection array **108** via the communication interface **206**. For example, one or more projections of the plurality of projections of the projection array **108** are provided with the humidity sensors to measure the humidity data **204**A associated with the insulation layer **106** and temperature sensors to measure the temperature data **204**B associated with the insulation layer **106**.

[0058] Thereafter, the comparison module **202**B is configured to compare the humidity data **204**A with a humidity threshold. For example, the humidity threshold is a pre-defined threshold that indicates an ideal range of moisture that may be present in the insulation layer **106**. For example, if the insulation layer **106**, or a region in the insulation layer **106** has a humidity level greater than the humidity threshold then the insulation layer **106** or the region may be considered as damp or having high moisture.

[0059] To this end, the humidity data **204**A sensed by a humidity sensor associated with a region may indicate a humidity level for the region. The comparison module **202**B may compare the humidity level with the humidity threshold to ascertain a humidity condition of the region. When the humidity level of the region is greater than the humidity threshold, a high humidity condition prone to mold growth is ascertained. Alternatively, when the humidity level of the region is less than the humidity threshold, a low humidity condition that is not prone to mold growth is ascertained. In this manner, the humidity data **204**A associated with different regions of the insulation layer **106** is compared with the humidity threshold to check if any region or the insulation layer **106** is prone to mold growth or not.

[0060] Based on the comparison, the output module **202**C is configured to generate a control signal or an instruction to trigger the heating element **110**. In particular, based on the determination that the humidity data **204**A for any region of the insulation layer **106** is greater than the humidity threshold, i.e., prone to mold growth, the heating process is initiated by triggering the heating element **110**. For example, the heating process is performed within a safe heating or temperature range of the insulation layer **106**. For example, the heating process may be performed until the humidity data **204**A of the insulation layer **106** is brought down, i.e., less than the humidity threshold.

[0061] In an example, the heating process comprises activating the heating element **110**, adjusting one or more vents provided in the projections or connected to the enclosing structure **104**, adjusting a humidity condition for the insulation layer **106**, and/or deactivating the heating element **110** when a cut-off is reached.

[0062] It may be noted, during the heating process, the humidity data **204**A and/or the temperature data **204**B may be continuously retrieved by the input module **202**A in real-time. Based on the continuously retrieved humidity data and/or the temperature data, the heating process, or an operation of the heating element **110** is controlled. For example, a temperature at which the heating element **110** operates or a time duration for which the heating element **110** operates may be controlled by the processor **202** of the controller **112**.

[0063] In an embodiment, the heating process may be performed until a desired temperature is reached within the insulation layer **106**. In this regard, the temperature data **204**B retrieved from the temperature sensors may be used to monitor the temperature of the insulation layer **106**.

[0064] In an embodiment, when the humidity data indicates that a humidity level of the insulation layer **106** has reached a cut-off, then another control signal may be generated for deactivating the heating element **110**. Alternatively, or additionally, when the temperature data indicates that a temperature of the insulation layer **106** has reached a cut-off, then another control signal may be generated for deactivating the heating element **110**.
[0065] In an example, the controller **112** includes a machine learning model **204**C. The machine learning model **204**C may be stored in the memory **204** and may be executed by the processor **202** to automatically trigger operation of the controller and/or the heating element. In an example, the machine learning (ML) model **204**C is used to analyze and interpret complex patterns within the humidity data **204**A and the temperature data **204**B. The ML model **204**C may be trained on historical environmental conditions and its impact on mold growth within different insulation materials as well as different geographical regions. For example, the ML model **204**C may utilize the learned insights to predict when the insulation layer **106** is prone to mold growth. Subsequently, preventive heating of the insulation layer **106** may be performed to further decrease the possibility of mold growth. The ML model **204**C enables proactively identifying areas at risk before mold growth. The ML model **204**C adapts and refines its prediction over time, continually improving its accuracy based on evolving environmental dynamics. The apparatus **102** provides an intelligent and dynamic mold prevention strategy, enhancing the overall effectiveness of an insulated wall structure in creating a resilient and mold-resistance environment.
[0066] FIG. **3** illustrates a flowchart **300** of an exemplary method for preventing mold growth, according to some embodiments. FIG. **3** is explained in conjunction with elements of FIG. **1**, and FIG. **2**. Although illustrated with discrete blocks, the exemplary operations associated with one or more blocks of the flowchart **300** may be divided into additional blocks, combined into fewer blocks, or eliminated, depending on the particular implementation.
[0067] The exemplary method starts at **302**.
[0068] At **304**, humidity data (H.sub.S) **204**A is collected. The humidity data **204**A is collected by the humidity sensors provided at some of the projections of the projection array **108**.
[0069] In an embodiment, the projection array **108** is arranged in connection, such as physical connection with the insulation layer **106**. In an example, a plurality of projection arrays may be arranged in association with the insulation layer **106**. For example, the plurality of projections may extend from a first side of a substrate of the projection array **108** and may extend across a length of the insulation layer **106**. In another example, the plurality of projections of the projection array **108** may extend from a first side of the insulation layer **106** and a plurality of projections of another projection array may extend from a second side of the insulation layer **106** across the length of the insulation layer **106**.
[0070] Pursuant to an example embodiment, the plurality of projections of the projection array **108** extends perpendicularly from a surface of at least one of: a first side, or a second side opposite to the first side, of the projection array **108** within the two sides of the insulation layer **106**. To this end, the first side and the second side of the projection array **108** may be opposing sides of the substrate of the projection array **108**. In an example, if the projection array **108** is rectangular, then the first side and the second side are opposing longitudinal faces of the projection array **108**.
[0071] Furthermore, the projections of the projections array **108** may host the humidity sensors to collect humidity data from different regions of the insulation layer **106**. In an example, the different regions may be zones or areas within the insulation layer **106**. In an example, the projections may be made such that the projections may extend and penetrate within the insulation layer **106** in different regions and at different angles.
[0072] Further, humidity data collected by a humidity sensor may indicate humidity condition or a level of humidity or moisture within a region associated with the humidity sensor. For example, the humidity sensor may be positioned within a particular region of an insulation layer form the insulation layer **106**. The humidity sensor may measure and collect humidity data for the particular

region. In this manner, humidity data **204**A is collected for different regions of the insulation layer **106**. For example, the humidity data is measured and collected in real-time within the enclosing structure **104**.

[0073] At **306**, a comparison between the humidity data **204**A and a humidity threshold (H.sub.T1) is performed. For example, the humidity data for different regions of the insulation layer **106** are compared with the humidity threshold. In an example, the humidity threshold is a pre-defined threshold. In another example, the humidity threshold is a dynamically determined threshold based on environmental or weather condition in which the apparatus **102** is operating. For example, in case of colder temperatures (such as during winter season), the humidity threshold may be set as a lower value, and in case of hot temperatures (such as during summer season), the humidity threshold may be set at a higher value. Subsequently, during winters, if humidity data for a region has higher humidity than the low humidity threshold, then mold prevention operation or the heating process is triggered. Alternatively, during summers, if humidity data for the region has higher humidity than the high humidity threshold, then mold prevention operation or the heating process is triggered. This ensures energy efficiency during different climatic conditions while ensuring proper mold prevention in the insulated wall structures.

[0074] In an example, if the humidity data for the region is less than the humidity threshold (H.sub.T1), then heating process is not initiated. In such a case, the process of measuring and collecting humidity data using humidity sensors is continued until there is any abnormality, i.e., higher humidity level than the humidity threshold. In certain cases, the process of collecting humidity data **204**A for different regions of the insulation layer **106** using humidity sensors and comparing the humidity data **204**A with the humidity threshold may be performed repeatedly, such as multiple times in a day, once every day, once every 2 days, once every week, etc. For example, such frequency of the data collection and comparison to monitor mold growth may be pre-defined by a user of the apparatus **102** and/or may be determined based on the environmental and weather conditions. For example, the frequency of monitoring humidity data may be increased during the monsoon season and/or the winter season, while the frequency of monitoring humidity data may be decreased in the summer season.

[0075] To this end, if the humidity data (H.sub.S) is greater than or equal to the humidity threshold, then the method moves to the **308**.

[0076] At step **308**, the heating process is triggered. In an example, the controller **112** is configured to generate a control signal to trigger the heating element **110** based on the comparison between the humidity data **204**A and the humidity threshold (H.sub.T1).

[0077] In an example, the heating process comprises activating the heating element **110**, adjusting one or more vents, adjusting a humidity condition for the insulation layer **106**, and deactivating the heating element **110** when a cut-off is reached. For example, the heating element **110** is activated by transmitting the control signal to the heating element **110** to initiate the heating process. The heating element **110** may conduct heat to the insulation layer **106** through the enclosing structure **104**. In certain cases, some projections of the projection array **108** may also host heating elements. In such a case, the regions within the insulation layer **106** are heated by heating elements in the projections. Moreover, some projections of the projection array **108** may host vents. In certain other cases, the vents may be arranged within the enclosing structure **104**. For example, the vents may be opening for exchange of gases. In an example, the vents may be openings or cavities that may allow moisture exchange from the insulation layer **106** to outside of the wall. In another example, the vents may be implemented using circulating devices, such as fans. This allows uniform heat dissipation across the regions of the insulation layer **106** and removal of moisture from the insulation layer **106**. Due to the heat conduction from the heating element **110** and the circulation of air for heat distribution and moisture removal, the humidity condition of the insulation layer **106** is adjusted. For example, the humidity condition of the insulation layer **106** is adjusted to decrease a humidity level of the insulation layer **106** in the enclosing structure **104** of the apparatus **102**.

[0078] Further, during the heating process, at **310**, temperature data (T.sub.S) **204**B is collected. In this regard, temperature sensors are used to measure and collect the temperature data **204**B. For example, some projections of the projection array **108** may host the temperature sensors. The temperature sensors may also be positioned within the insulation layer **106**. For example, during the heating process, the temperature sensors may continuously retrieve temperature data **204**B associated with different regions of the insulation layer **106**. In an example, the temperature data **204**B may indicate a temperature level (such as in degree Celsius or degree Fahrenheit) of the different regions of the insulation layer **106**.
[0079] At **312**, the temperature data **204**B is compared with a temperature threshold (T.sub.T2). For example, the temperature data **204**B associated with a particular region of the insulation layer **106** is compared with the temperature threshold (T.sub.T2). Based on the comparison, temperature parameter of the region of the insulation layer **106** is determined.
[0080] When a temperature level for the region or the insulation layer **106** is less than the temperature threshold, the heating process is continued. In other words, the heating element **110** remains active when the temperature level is less than the temperature threshold. Alternatively, when a temperature level for the region or the insulation layer **106** is greater than or equal to the temperature threshold, the cut-off is reached. When the cut-off is reached, the heating element **110** is deactivated. In this manner, the heating process is performed within a safe temperature range to heat the insulation layer **106**. The safe heating ensures longevity of the insulation layer **106** without causing any faults in the insulation layer **106** while creating unfavorable condition for mold growth.
[0081] In an embodiment, the humidity sensors may also continually sense and collect humidity data for the different regions of the insulation layer **106** during the heating process in real-time. Subsequently, the controller **112** is configured to continuously retrieve the real-time humidity data after initiating the heating process. In an example, the humidity data collected in real-time is used to monitor humidity condition of the different regions. In such cases, the deactivation of the heating element **110** may be performed based on the real-time humidity data.
[0082] For example, the controller **112** is configured to determine whether current real-time humidity data from the retrieved real-time humidity data is substantially equal to a cut-off humidity threshold. The controller **112** is configured to compare the humidity level indicated by the retrieved real-time humidity data with the cut-off humidity threshold. In an example, when a current humidity level of a region of the insulation layer **106** or the insulation layer **106** is substantially equal to the cut-off humidity threshold, a cut-off condition is met.
[0083] Thereafter, based on the determination of the cut-off condition, the controller **112** is configured to generate a control signal for deactivating the heating element **110**. The heating element **110** is deactivated to terminate the heating process. For example, when the humidity level is less than the cut-off humidity threshold, then moisture level is reduced, and mold growth condition has been averted. Subsequently, the heating process is deactivated or stopped.
[0084] Although the embodiments of the present disclosure are described with reference to a single apparatus **102** as an insulated wall structure. However, this should not be construed as a limitation. In other examples, the insulated wall structure may include plurality of apparatuses. Each of the apparatuses may include corresponding enclosing structures, controllers, and heating elements. Alternatively, the controller **112** and/or the heating element **110** may be used in conjunction with the different enclosing structures (similar to the enclosing structure **104**) to collect data from the projection arrays of different enclosing structures to control the heating process.
[0085] The flowchart **300** terminates at **314**.
[0086] FIG. **4**A illustrates an exemplary diagram **400**A of a wall structure **402** for receiving an insulated module, according to some embodiments. The wall structure **402** forms a mould or a frame for receiving the insulated module. In this regard, the wall structure **402** includes a cavity **406** defined within a frame **404**. The cavity **406** defines a hollow space for receiving the insulated

module. Details of the insulated module are further described in conjunction with FIG. **4**B, **5**A and **5**B.

[0087] FIG. **4**B illustrates an exemplary diagram **410** of a plurality of insulated modules (depicted as insulated modules **408**A, **408**B, **408**C, **408**D and **408**E) according to the present disclosure fitted within the wall structure **402**, according to some embodiments. In an example, the apparatus **102** is used to implement the insulated walls **408**A, **408**B, **408**C, **408**D and **408**E (collectively referred to as insulated walls **408**) of a building. Examples of the building may include, but are not limited to, residential building, commercial building, educational buildings, storage building, and industrial building.

[0088] An insulated wall, say the insulated wall **408**A may include the heat-conductive enclosing structure **104**, the insulation layer **106** that provides insulation from the environmental conditions and the projection array **108** extending projections (depicted as projections **412**A, **412**B and **412**C) within the insulation layer **106**. In an example, the insulation layer **106** is an insulation foam. To this end, the insulation layer **106** is prone to mold growth because of high moisture levels. The insulation foam may be composed of various substances such as polystyrene, polyurethane, or cellulose. The insulation foam may have different densities and thicknesses depending on the desired thermal resistance and structural strength.

[0089] In an example, enclosing structure **104** is made of a heat-conductive material. For example, the enclosing structure **104** is made of iron mesh. The iron mesh structure of the enclosing structure **104** is described in detail in conjunction with FIG. **5**A. The enclosing structure **104** is used to enclose the insulation layer inside the wall structure **402** of a building.

[0090] The projection array **108** includes the projections **412**A, **412**B and **412**C. For example, each of the projections **412**A, **412**B and **412**C may host humidity sensors **414**A, **414**B and **414**C, respectively. The projections **412**A, **412**B and **412**C (collectively referred to as projections **412**) may position the humidity sensors **414**A, **414**B and **414**C (collectively referred to as humidity sensors **414**) into different regions of the insulation layer **106**. The humidity sensors **414** may measure humidity data **204**A and transmit the humidity data **204**A to the controller **112**. Additionally, the projections **412** may also host temperature sensors, vents, and heating elements for different regions of the insulation layer **106**. Details of the projection array **108** are described in conjunction with FIG. **1**, FIG. **2**, and FIG. **5**B.

[0091] Further, the heating element **110** (not shown in FIG. **4**B) is mechanically coupled with the enclosing structure **104**. The heating element **110** is supplied by a power source to generate heat. Further, the heat is transferred to the insulation layer **106** through conduction via the enclosing structure **104**.

[0092] The controller **112** is communicatively coupled with the humidity sensors **414** and the heating element **110**. The controller **112** is configured to receive the humidity data **204**A of the different regions of the insulation layer **106**. Further, the controller **112** is configured to compare humidity data of each region of the insulation layer **106** with a humidity threshold. Based on the comparison, the controller **112** may check if a region of the insulation layer **106** is damp or prone to mold growth. In an example, based on whether a humidity level is greater than the humidity threshold or not, mold growth condition is ascertained. When the humidity level is greater than the humidity threshold, the controller **112** may generate a control signal to activate the heating element **110** to trigger a heating process. Due to the heating, the moisture content of the insulation layer **106** is reduced, and mold growth is prevented. Further, the controller **112** is also configured to generate another control signal to deactivate the heating element **110** when a cut-off humidity threshold is reached and/or a cut-off temperature threshold is reached.

[0093] In an example, the controller **112** may utilize the ML model **204**C to learn a correlation between the humidity data **204**A, the temperature data **204**B as well as environmental or weather information with an occurrence of mold growth in the insulation layer **106** of the wall structure **402**. The ML model **204**C is configured to, for example, predict when to initiate the heating process, dynamically determine the humidity threshold, and predict desired humidity level and/or desired temperature level for the insulation layer **106** to prevent mold growth.

[0094] In an embodiment, the controller **112** is configured to proactively communicate critical information to a user associated with the wall structure **402** through alert messages. The alert message serves to convey details, including real-time humidity data, and/or a status of heating element **110**. The controller **112** is configured to transmit the alert message to a user device. The alert message act as a real-time notification system, providing users with insights into the ongoing status of the apparatus **102** or the insulated modules **408** of the wall structure **402**.

[0095] FIG. **5**A illustrates an exemplary schematic diagram **500**A of the enclosing structure **104**, according to some embodiments. The enclosing structure **104** is made of heat conductive material, such as but not limited to iron mesh net cage. The iron mesh cage is designed to define a chamber **502** to enclose the insulation layer **106** in the wall structure **402** and provide a proactive measure against mold formation.

[0096] The heating element **110** may get activated to initiate the heating process. Subsequently, the enclosing structure **104** may also conduct heat to the insulation layer **106** to dry out the moisture and prevent the growth of mold spores. The heating element **110** is in contact with the enclosing structure **104** to cause the enclosing structure **104** to transfer heat when the heating element **110** is activated. This means that the enclosing structure **102** may act as a heat conductor and distribute the heat to the insulation layer **106** of the wall structure **402**.

[0097] In an example, a user may control and adjust the operation of the heating element **110** remotely, such as through a mobile app or a web interface executed on a user device. In this regard, the controller **112** is remotely connected to the user device. The controller **112** is configured to receive a control input from the user device. The control input is associated with a temperature control of the insulation layer **106**. In an example, the control input may indicate a desired temperature value to regulate temperature of the building or a room associated with the wall structure **402**. In an example, the temperature control may be for heating of the building or the room. For example, by using the apparatus **102** within the wall structure **402** as insulated modules **408**, the mold growth prevention and temperature regulation within the building is performed simultaneously. This enhances energy efficiency of the building.

[0098] Further, the controller **112** is configured to generate a temperature control signal for the heating element **110** based on the control input. The controller **112** may transmit the temperature control signal to the heating element **110** to initiate the temperature control. In this manner, the temperature of the wall structure **402** within the building is regulated.

[0099] The projection array **108** having the projections **412** may be inserted into the enclosing structure **104**. The projection array **108** is inserted such that the projections **412**A, **412**B and **412**C penetrate within the insulation layer **106** in the enclosing structure **104**.

[0100] FIG. **5**B illustrates an exemplary schematic diagram **500**B of the projection array **108**, according to some embodiments. For example, the projection array **108** may include a plurality of projections **412**. In an example, the projections **412** of the projection array **108** may extend from a single side or a first side **504** of a substrate **506**. In another example, the projections of the projection array **108** may extend from the first side **504** as well as a second side **508** of the substrate **506**. The first side **504** and the second side **508** may be opposing sides of the substrate **506** of the projection array **108**. For example, the projections **412** may extend from the first side **504** of the substrate **506** towards the insulation layer **106**.

[0101] In an example, the insulation layer **106** includes a plurality of regions, and wherein each of the plurality of regions includes at least one projection hosting the humidity sensor, at least one projection in connection with the heating element **110**, and at least one projection hosting the temperature sensor. In other words, the different regions of the insulation are defined based on areas in which the projections **412** extend. Each of the regions of the insulation layer **106** is provided with a single projection hosting multiple sensors, heating element **510** and vents, or multiple projections. The projections **412** may have outlets supplied from a power source to host temperature sensor, humidity sensor and heating element **510**. The temperature sensor of a projection, say the projection **412**A may measure temperature data associated with a region of the projection **412**A in the insulation layer **106**; and the humidity sensor **414**A of the projection **412**A may measure humidity data associated with the region of the projection **412**A of the insulation layer **106**. Further, during the heating process, the projection **412**A may perform localized heating of the region of the projection **412**A using the heating element **510** that is in connection with the heating element **110**.

[0102] The overall space of the insulation layer **106** within the enclosing structure **104** is compartmentalized into the plurality of regions, each region serving as a discrete unit for mold prevention. The segmentation of the insulation layer **106** further into the plurality of regions allows for targeted and zone-specific interventions, optimizing the efficiency of the apparatus **102**. By dividing the insulation layer **106** into multiple regions, the apparatus **102** can more accurately assess and respond to variation in humidity levels. Each region of the insulation layer **106** is equipped with at least one humidity sensor hosted by a projection of the projection array **108** facilitating precise data collection for localized analysis. The humidity sensors continuously capture real-time moisture levels, providing essential data for mold growth.

[0103] Each of the projections **412** may include an outlet. The outlets of the projections **412** may host humidity sensors **414**, temperature sensors, heating element **510** and/or or a vent for heat distribution. In an example, some projections from the projections **412** may host humidity sensors **414** such that the projections **412** that extend in each of different regions of the insulation layer **106** have at least one humidity sensor **414**. Similarly, some of the projections from the projections **412** may host temperature sensors, vents, and heating elements. Subsequently, each of the different regions of the insulation layer **106** has at least one humidity sensor, temperature sensor heating element and vent. For example, the insulation layer **106** is divided into three different regions. In such a case, each of the three regions would include projections **412**. The projection **412**A in a region from the three regions would host the humidity sensor **414**A, temperature sensor, heating element **510** and vent.

[0104] In an example, the heating elements **510** hosted by the projections **412** are in connection with the heating element **110**. Subsequently, the heating element **110** may conduct heat to the insulation layer **106** through the projections **412** during the heating process.

[0105] In an example, the controller **112** is configured to detect a humidity condition for each of the plurality of regions of the insulation layer **106** based on the corresponding humidity data and the humidity threshold. Subsequently, the controller **112** is configured to transmit a control signal to the heating element **110** associated with the insulation layer **106** or projections in association with the heating element **110** to conduct heat in the at least one region to initiate the heating process.

[0106] The humidity condition may indicate if the regions of the insulation layer **106** have high moisture level or not such that the humidity condition is prone to mold growth or not. In an example, when the controller **112** determines that a particular region or a particular insulation layer is prone to mold growth, i.e., the humidity level indicated by the humidity data for the region or the insulation layer is higher than the humidity threshold, the controller **112** is configured to activate the heating element **110** to heat the particular region or the insulation layer **106**. In an example, the heating element **110** may heat the insulation layer **106** by conducting heat through the enclosing structure **104**. In another example, the heating element **110** may heat particular regions within the insulation layer **106** using heating element **510** hosted within the projection in the corresponding regions.

[0107] FIG. **5**C illustrates an exemplary schematic diagram **500**C of the enclosing structure **104** housing the projection array **108**, according to some embodiments. The enclosing structure **104** defines the chamber **502** that receives the insulation layer **106**.

[0108] The projection array **108** is arranged inside the enclosing structure **104**. The projection array is arranged in association with the insulation layer **106**. In an example, the projection array **108** is inserted from a front of the enclosing structure **104** or the insulation layer **106**. In another example, the projection array **108** is inserted from a side of the enclosing structure **104** or the insulation layer **106**. The projections **412** of the projection array **108** may extend across a width or a thickness of the insulation layer **106**. Further, the humidity sensors **414** on the projections **412** of the projection array **108** may collect humidity data for different regions of the insulation layer **106**.

[0109] For example, the projection **412**A may host the humidity sensor **414**A to measure humidity data for a region of the insulation layer **106**. Further, the humidity sensor **414**A or the projection array **108** may transmit the humidity data to the controller **112**. The humidity data may be transmitted through wireless or wired network. The controller **112** may compare a humidity level indicated by the humidity data with the humidity threshold. Based on detecting that the humidity level of the region is greater than the humidity threshold, the controller **112** may send a control signal to the heating element **110** or the heating element **510** to trigger a heating process. During the heating process, the heating element **510** of the projection **412**A may conduct heat **516** to the region of the insulation layer **106**. In this manner, humidity in the insulation layer **106** is managed to prevent mold growth.

[0110] FIG. **6** illustrates a flowchart **600** of a method for preventing mold growth, according to some embodiments. FIG. **6** is explained in conjunction with elements from FIG. **1**, FIG. **2**, FIG. **3**, FIG. **4**A, FIG. **4**B, FIG. **5**A, FIG. **5**B, and FIG. **5**C. The operations of the flowchart **600** may be executed by any computing system, for example, by the controller **112**.

[0111] At **602**, humidity data **204**A is iteratively retrieved. The humidity data **204**A is retrieved by the controller **112** from humidity sensors **414** hosted by the projections **412** of the projection array **108**. The projection array **108** is arranged in connection with the insulation layer **106**. Subsequently, the projections **412** may extend from the substrate **506** of the projection array **108** to the different regions of the insulation layer **106**. In an example, the humidity data collected from a humidity sensor for a region of the insulation layer **106** may indicate a humidity level.

[0112] At **604**, humidity condition for the insulation layer **106** is detected. In an example, the controller **112** is configured to compare the humidity level indicated for the region of the insulation layer **106** with a humidity threshold to ascertain whether the region of the insulation layer **106** has high moisture level or not. When the humidity level is greater than or equal to the humidity threshold, high moisture is ascertained. In such a case, the humidity condition for the region of the insulation layer **106** is determined to be prone to mold growth.

[0113] At **606**, a control signal is generated and transmitted to the heating element **110** to initiate a heating process. In an example, the controller **112** is configured to generate the control signal based on detecting the humidity condition to be prone to mold growth. The control signal may be transmitted to the heating element **110** to activate the heating element **110** and initiate the heating process. In an example, during the heating process, the heating element **110** may conduct heat to the insulation layer **106** via the enclosing structure **104**. In another example, during the heating process, the heating element **110** may conduct heat to the insulation layer **106** via the enclosing structure **104** as well as targeted regions of the insulation layer **106** via the projection(s) in the region under consideration hosting the heating element. **510**

[0114] During the heating process, real-time humidity data and real-time temperature data for the region is continuously retrieved. For example, when the controller **112** determines that a humidity level from the real-time humidity data is less than a cut-off humidity threshold, then another control signal is generated to deactivate the heating element **110**, i.e., stop the heating process. Alternatively, or additionally, when the controller **112** determines that a temperature level from the real-time temperature data is more than a cut-off temperature threshold, then another control signal is generated to deactivate the heating element **110**, i.e., stop the heating process. The control signals are transmitted to the heating element **110** through the communication module **206**.

[0115] Many modifications and other embodiments of the inventions set forth herein will come to mind to one skilled in the art to which these inventions pertain having the benefit of the teachings presented in the foregoing descriptions and the associated drawings. It is to be understood that the inventions are not to be limited to the specific embodiments disclosed and that modifications and other embodiments are intended to be included within the scope of the appended claims. Moreover, although the foregoing descriptions and the associated drawings describe example embodiments in the context of certain example combinations of elements and/or functions, it should be appreciated that different combinations of elements and/or functions may be provided by alternative embodiments without departing from the scope of the appended claims. In this regard, for example, different combinations of elements and/or functions than those explicitly described above are also contemplated as may be set forth in some of the appended claims. Although specific terms are employed herein, they are used in a generic and descriptive sense only and not for purposes of limitation.

Claims

1. An apparatus for controlling mold growth, comprising: an enclosing structure defining a chamber therewithin to receive an insulation layer, wherein the enclosing structure is made of a heat conductive element; a projection array arranged in association with the insulation layer, wherein the projection array comprises a plurality of projections extending within the insulation layer, and wherein at least some of the plurality of projections are configured to host a humidity sensor to measure humidity data of the insulation layer; a heating element mechanically coupled with the enclosing structure, wherein the heating element is configured to generate heat to cause the enclosing structure to conduct heat to the insulation layer; and a controller communicatively coupled with the humidity sensor and the heating element, wherein the controller is configured to generate a control signal to trigger the heating element based on a comparison between the humidity data and a humidity threshold.
2. The apparatus of claim 1, wherein a plurality of projection arrays is arranged within the insulation layer.
3. The apparatus of claim 1, wherein the plurality of projections of the projection array extends perpendicularly from a surface of at least one of: a first side, or a second side opposite to the first side, of the projection array within the insulation layer.
4. The apparatus of claim 1, wherein the heating process comprises at least one of: activating the heating element, adjusting one or more vents, adjusting a humidity condition for the insulation layer, and deactivating the heating element when a cut-off is reached.
5. The apparatus of claim 1, wherein one or more projections of the plurality of projections are in connection with the heating element, and wherein the heating element conducts heat to the insulation layer through the one or more projections during the heating process.
6. The apparatus of claim 1, wherein each of the plurality of projections includes an outlet for hosting at least one of: the humidity sensor, a temperature sensor, a heating element, or a vent for heat distribution.
7. The apparatus of claim 1, wherein the insulation layer includes a plurality of regions, and wherein each of the plurality of regions includes at least one projection hosting the humidity sensor, at least one projection in connection with the heating element, and at least one projection hosting a temperature sensor.
8. The apparatus of claim 7, wherein the controller is configured to: detect a humidity condition for each of the plurality of regions of the insulation layer based on the corresponding humidity data and the humidity threshold; and based on detecting the humidity condition for at least one region from the plurality of regions to be prone to mold growth, transmit a control signal to the at least one projection in connection with the heating element associated with the at least one region to initiate the heating process.

9. The apparatus of claim 1, wherein the controller is remotely connected to a user device, and wherein the controller is configured to: receive a control input from the user device, wherein the control input is associated with a temperature control of the plurality of insulation layer; generate a temperature control signal for the heating element based on the control input; and transmit the temperature control signal to the heating element to initiate the temperature control.
10. The apparatus of claim 1, wherein the controller is configured to: continuously retrieve real-time humidity data after initiating the heating process; determine whether current real-time humidity data from the retrieved real-time humidity data is substantially equal to a cut-off humidity threshold; and based on the determination, generate a control signal for deactivating the heating element.
11. The apparatus of claim 1, wherein one or more projections of the plurality of projections are provided with a temperature sensor to measure temperature data associated with the insulation layer.
12. The apparatus of claim 1, wherein the enclosing structure is made of iron mesh.
13. The apparatus of claim 1, wherein the enclosing structure is used to enclose the insulation layer inside a wall of a building.
14. An insulation module for a wall structure, comprising: an enclosing structure defining a chamber therewithin to receive an insulation layer, wherein the enclosing structure is made of a heat conductive element; a projection array arranged in association with the insulation layer, wherein the projection array comprises a plurality of projections extending within the insulation layer, and wherein at least some of the plurality of projections are configured to host a humidity sensor to measure humidity data of the insulation layer; a heating element mechanically coupled with the enclosing structure, wherein the heating element is configured to generate heat to cause the enclosing structure to conduct heat to the insulation layer; and a controller communicatively coupled with the humidity sensor and the heating element, wherein the controller is configured to generate a control signal to trigger the heating element based on a comparison between the humidity data and a humidity threshold.
15. The insulated wall structure of claim 14, wherein a plurality of projection arrays is arranged within the insulation layer.
16. The insulated wall structure of claim 14, wherein the plurality of projections of the projection array extends perpendicularly from a surface of at least one of: a first side, or a second side opposite to the first side, of the projection array within the insulation layer.
17. The insulated wall structure of claim 14, wherein the heating process comprises at least one of: activating the heating element, adjusting one or more vents, adjusting a humidity condition for the insulation layer, and deactivating the heating element when a cut-off is reached.
18. The insulated wall structure of claim 14, wherein one or more projections of the plurality of projections are in connection with the heating element, and wherein the heating element conducts heat to the insulation layer through the one or more projections during the heating process.
19. A method for controlling mold growth, wherein the method is implemented using an apparatus comprising: an enclosing structure defining a chamber therewithin to receive an insulation layer, wherein the enclosing structure is made of a heat conductive element; a projection array arranged in association with the insulation layer, wherein the projection array comprises a plurality of projections extending within the insulation layer, and wherein at least some of the plurality of projections are configured to host a humidity sensor to measure humidity data of the insulation layer; a heating element mechanically coupled with the enclosing structure, wherein the heating element is configured to generate heat to cause the enclosing structure to conduct heat to the insulation layer; and a controller communicatively coupled with the humidity sensor and the heating element, wherein the method comprises: iteratively retrieving the humidity data; detecting humidity condition for the insulation layer based on the humidity data and a humidity threshold; and based on detecting the humidity condition to be prone to mold growth, generating and

transmitting a control signal to the heating element to initiate a heating process.

20. The method of claim 19, further comprising: receiving a control input from a user device, wherein the control input is associated with a temperature control of the insulation layer; generating a temperature control signal for the heating element based on the control input; and transmitting the temperature control signal to the heating element to initiate the temperature control.