



US 20220018178A1

(19) **United States**

(12) **Patent Application Publication**
COOPER et al.

(10) **Pub. No.: US 2022/0018178 A1**

(43) **Pub. Date: Jan. 20, 2022**

(54) **INSULATING GLASS UNIT WITH
DESICCANT MATERIAL, AND/OR
ASSOCIATED METHODS**

E06B 9/24 (2006.01)

E06B 3/67 (2006.01)

(52) **U.S. Cl.**

CPC *E06B 3/677* (2013.01); *B01J 20/28026*

(2013.01); *E06B 3/66376* (2013.01); *E06B*

2009/2464 (2013.01); *E06B 9/24* (2013.01);

E06B 3/6722 (2013.01); *B01J 20/046*

(2013.01)

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(57)

ABSTRACT

Certain example embodiments relate to an insulating glass (IG) unit. A spacer system is interposed between first and second substrates. The spacer system helps to maintain the first and second substrates in substantially parallel spaced apart relation to one another, and to define a cavity between the first and second substrates. A desiccant material is located in a body of the spacer system, with the desiccant material comprising a desiccant matrix and a molecular sieve replacement material formed for adsorption at a relative humidity of 10-20%. The molecular sieve replacement material may be a salt or other material (such as, for example, MgCl₂, CaCl₂, CaO, MgSO₄, and/or the like). The cavity may be primarily filled with an inert gas (such as Ar, Kr, Xe, or the like) or a reactive gas (such as CO₂). An electrostatically-driven dynamic shade may be provided in the cavity.

(21) Appl. No.: **17/375,243**

(22) Filed: **Jul. 14, 2021**

Related U.S. Application Data

(60) Provisional application No. 62/705,776, filed on Jul. 15, 2020.

Publication Classification

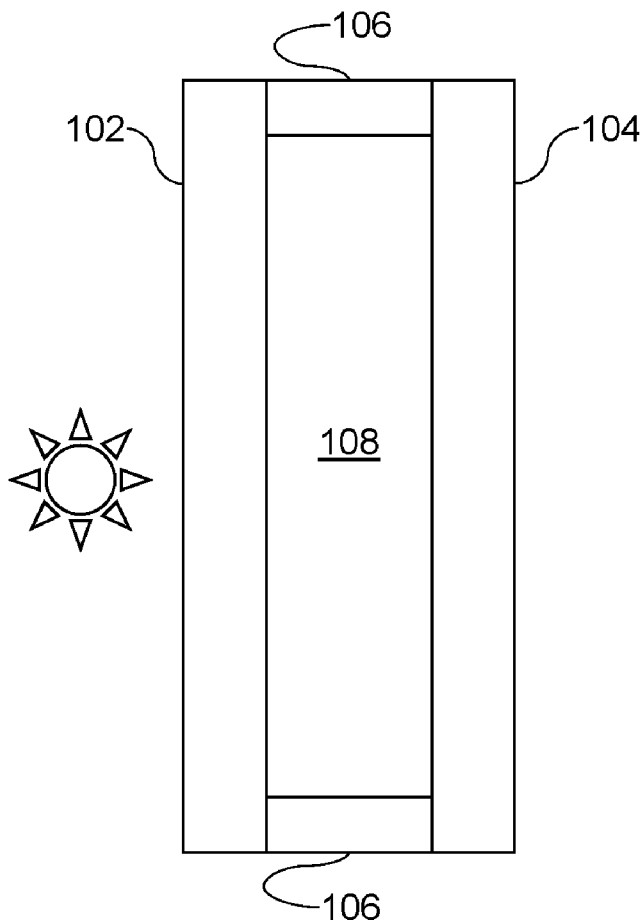
(51) **Int. Cl.**

E06B 3/677 (2006.01)

B01J 20/28 (2006.01)

E06B 3/663 (2006.01)

B01J 20/04 (2006.01)



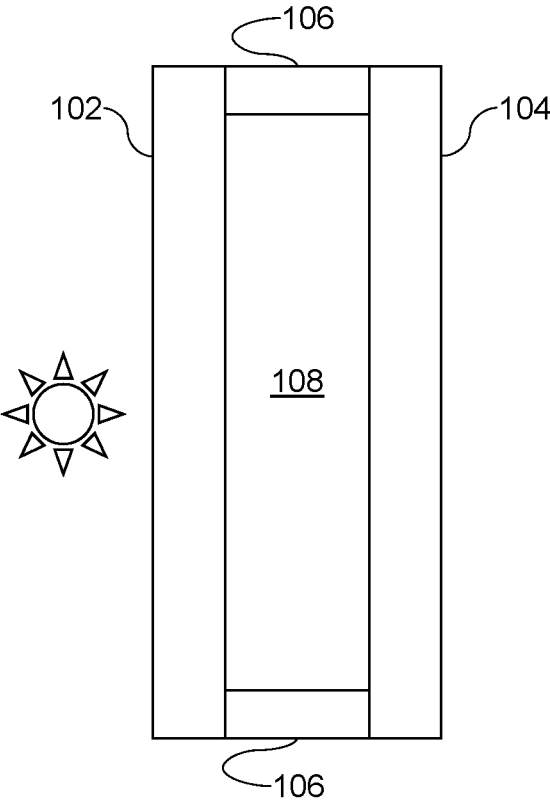


Fig. 1

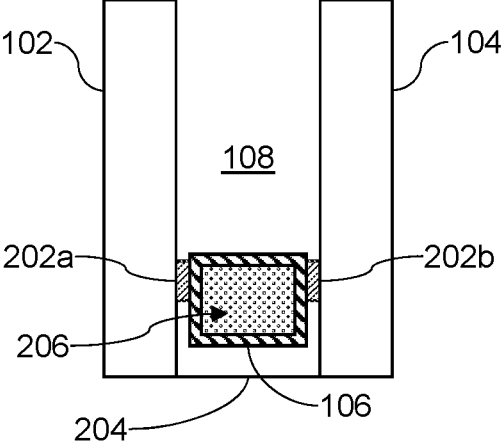


Fig. 2

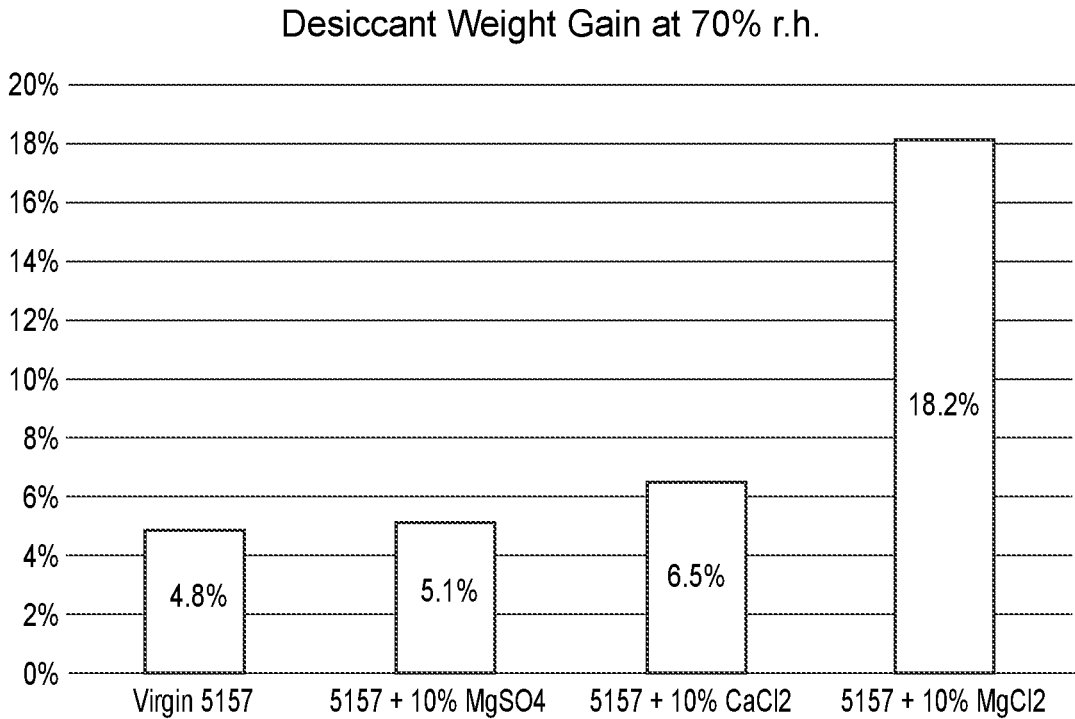


Fig. 3

INSULATING GLASS UNIT WITH DESICCANT MATERIAL, AND/OR ASSOCIATED METHODS

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of U.S. Application Ser. No. 62/705,776 filed on Jul. 15, 2020, the entire contents of which are hereby incorporated herein by reference.

TECHNICAL FIELD

[0002] Certain example embodiments of this invention relate to insulating glass units (IG units or IGUs), and/or associated methods. For example, certain example embodiments of this invention relate to improved desiccant materials that can be used with IG units, IG units with such desiccant materials, and/or methods of making the same.

BACKGROUND AND SUMMARY

[0003] The building sector is known for its high energy consumption, which has been shown to represent 30-40% of the world's primary energy expenditure. Operational costs, such as heating, cooling, ventilation, and lighting account for the better part of this consumption, especially in older structures built under less stringent energy efficiency construction standards.

[0004] Windows, for example, provide natural light, fresh air, access, and connection to the outside world. However, they oftentimes also represent a significant source of wasted energy. With the growing trend in increasing the use of architectural windows, balancing the conflicting interests of energy efficiency and human comfort is becoming more and more important. Furthermore, concerns with global warming and carbon footprints are adding to the impetus for novel energy efficient glazing systems.

[0005] In this regard, because windows are usually the "weak link" in a building's isolation, and considering modern architectural designs that often include whole glass facades, it becomes apparent that having better insulating windows would be advantageous in terms of controlling and reducing energy waste. There are, therefore, significant advantages both environmentally and economically in developing highly insulating windows.

[0006] Insulating glass units (IG units or IGUs) have been developed and provide improved insulation to buildings and other structures. FIG. 1 is a cross-sectional, schematic view of an example IG unit. In the FIG. 1 example IG unit, first and second substrates 102 and 104 are substantially parallel and spaced apart from one another. The first and second substrates 102 and 104 quite often are glass substrates. A spacer system 106 is provided at the periphery of the first and second substrates 102 and 104, helping to maintain the first and second substrates 102 and 104 in substantially parallel spaced apart relation to one another, and helping to define a gap or space 108 therebetween. The gap 108 may be at least partially filled with an inert gas (such as, for example, Ar, Kr, Xe, and/or the like) in some instances, e.g., to improve the insulating properties of the overall IG unit. A mixture of a noble gas and air (e.g., 80% Ar and 20% air) may be provided in the gap 108. Optional outer seals may be provided in addition to the spacer system 106 in some

instances. In some example configurations, the spacer system 106 forms an inner or primary seal, whereas the outer seal forms a secondary seal.

[0007] FIG. 2 is an enlarged cross-section view of an end portion of the FIG. 1 example IG unit. As will be appreciated from this description, the spacer system 106 forms a generally rectangular frame around the IG unit. The FIG. 2 cross-sectional view shows the spacer system being bonded or otherwise adhered to the inner surfaces of the first and second substrates 102 and 104 using materials 202a and 202b. The outer seal 204 is provided external to the spacer system 106, remote from the gap 108.

[0008] The spacer system 106 and the outer seal 204 function together, forming a sealant system helps keep moisture out of the gap 108 and helps keep the noble fill gas in the cavity 108. This seal helps prolong the life of the IG unit, making it more effective in terms of its solar insulating properties by virtue of the noble fill gas and keeping it aesthetically pleasing by virtue of the reduction of the ingress of moisture (which otherwise could cause the IG unit to fog up, appear cloudy, etc.).

[0009] There are a number of different possible spacer systems that are used in different configurations. One example uses two metal sheets separated by nylon legs to form a generally rectangular frame with a cavity. This general configuration is used in Guardian IG spacers, for example. See, for example, U.S. Pat. Nos. 8,795,568; 8,967,219; 9,187,949; 9,309,714; 9,617,781; 9,656,356; 9,689,196; and 10,233,690, which set forth example spacer formation and application techniques. The entire contents of each of these patents is hereby incorporated herein by reference.

[0010] As shown in the FIG. 2 example, the spacer system 106 is at least partially filled with a desiccant 206. In one example, the desiccant 206 is provided in the spacer system 106, which has a limited space (e.g., about 4.5 mm×2.5 mm in a common configuration). The desiccant 206 typically will be extruded into this space. However, different approaches of providing the desiccant material may be used in different instances. Typically, loose fill powder and/or bead desiccant materials, and materials that agglomerate out to such materials, will not be used. This is because typical downstream processing makes it likely that desiccant material will escape from the spacer system 106 and impart a visual obstruction within the air cavity of the IG unit.

[0011] The desiccant 206 adsorbs moisture over the life of the IG unit, which typically is more than 20 or 25 years. Once the desiccant 206 is fully saturated, the inner cavity moisture vapor pressure rises, and water can condense on the inner surface, stain the glass, and render the IG defective (or at least aesthetically displeasing). In a sense, one of the main functions of the IG unit, namely, being able to see through it clearly, is compromised.

[0012] Thus, it will be appreciated that it would be desirable to provide improved desiccant materials. By design, a desiccant helps address the small vapor transmission directly through the seals in a well-designed and built IG unit, as all seal materials generally have real-world permeation rates. Doing so can, for example, help prolong the effective life of the IG units by virtue of helping to compensate for poor or failing (and perhaps sometimes failed) seals, while also helping to maintain solar performance and aesthetics, and potentially enabling different gasses to be used inside of the IG units, etc.

[0013] Certain example embodiments address these and/or other concerns. For example, certain example embodiments relate to improved desiccant materials that can be used with IG units, IG units with such desiccant materials, and/or methods of making the same.

[0014] In certain example embodiments, there is provided an insulating glass unit, comprising first and second substrates. A spacer system is interposed between the first and second substrates, with the spacer system helping to maintain the first and second substrates in substantially parallel spaced apart relation to one another and to define a cavity between the first and second substrates. A desiccant material comprises a desiccant matrix and a molecular sieve replacement material formed for adsorption at a relative humidity of 10-20%, with the desiccant material being located in a body of the spacer system.

[0015] In certain example embodiments, a method of making an IG is provided. The method comprises having first and second substrates; and connecting together the first and second substrates in connection with a spacer system interposed between the first and second substrates, the spacer system helping to maintain the first and second substrates in substantially parallel spaced apart relation to one another and to define a cavity between the first and second substrates. A desiccant material is provided in a body of the spacer system, the desiccant material comprising a desiccant matrix and a molecular sieve replacement material formed for adsorption at a relative humidity of 10-20%.

[0016] In certain example embodiments, a desiccant material comprises a desiccant matrix and a molecular sieve replacement material formed for adsorption at a relative humidity of 10-20%, the desiccant material being located in a body of the spacer system.

[0017] According to certain example embodiments, the desiccant material may further comprise a molecular sieve different from the molecular sieve replacement material. Thus, in certain example embodiments, the molecular sieve replacement material may fully or partially replace an otherwise present molecular sieve. The molecular sieve replacement material itself may or may not be a molecular sieve in different example embodiments.

[0018] According to certain example embodiments, the molecular sieve replacement material may comprise 5-25% (more preferably 10-20%) of the desiccant material or may amount to 5-25% (more preferably 10-20%) of the other desiccant material.

[0019] According to certain example embodiments, the molecular sieve replacement material may comprise a salt. According to certain example embodiments, the molecular sieve replacement material may comprise $MgCl_2$, $CaCl_2$, CaO , and/or the like.

[0020] According to certain example embodiments, the cavity of the IG unit may be at least partially filled with a reactive gas such as, for example, CO_2 . The use of a reactive gas such as CO_2 in an IG unit cavity may be beneficial for applications that include electronic devices such as, for example, dynamically controllable shade application. CO_2 and some other reactive gasses are not compatible with molecular sieves so, in such cases, desiccant materials may lack molecular sieve materials.

[0021] According to certain example embodiments, a dynamically controllable shade may be interposed between the first and second substrates, with the shade including: a first conductive layer provided, directly or indirectly, on the

interior major surface of the first substrate; and a shutter including at least one polymer substrate, first and second conductive coatings, and first and second dielectric layers. The at least one polymer substrate may be extendible to a shutter closed position and retractable to a shutter open position. The first and/or second conductive coatings may be electrically connectable to a power source that is controllable to set up an electric potential difference to create first electrostatic forces to drive the at least one polymer substrate to the shutter closed position. According to certain example embodiments, another electrically-powered device may be embedded in the cavity in place of, or in addition to, the shade. This may be, for example, a lighting element, an Internet-of-Things device, and/or the like.

[0022] In certain example embodiments, an IG unit is provided. The IG unit comprises first and second substrates. A spacer system is interposed between the first and second substrates, with the spacer system helping to maintain the first and second substrates in substantially parallel spaced apart relation to one another and to define a cavity between the first and second substrates. A desiccant material comprises a desiccant matrix and a molecular sieve replacement material formed for adsorption at a relative humidity of 10-20%, and the desiccant material is located in a body of the spacer system.

[0023] In certain example embodiments, there is provided a method of making an IG unit, the method comprising: having first and second substrates; and connecting together the first and second substrates in connection with a spacer system interposed between the first and second substrates, the spacer system helping to maintain the first and second substrates in substantially parallel spaced apart relation to one another and to define a cavity between the first and second substrates. A desiccant material is provided in a body of the spacer system, the desiccant material comprising a salt and lacking a molecular sieve.

[0024] In certain example embodiments, there is provided a desiccant material comprising a molecular sieve replacement material formed for adsorption at a relative humidity of 10-20%, the desiccant material being locatable in a body of the spacer system, with the molecular sieve replacement material comprising a salt, the desiccant material lacking a molecular sieve.

[0025] In certain example embodiments, the desiccant material may be extruded or injected into the body of the spacer system, provided to the body of the spacer system as the spacer system is being formed, provided to the body of the spacer system as the first and second substrates are being secured to one another, etc.

[0026] The features, aspects, advantages, and example embodiments described herein may be combined to realize yet further embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027] These and other features and advantages may be better and more completely understood by reference to the following detailed description of exemplary illustrative embodiments in conjunction with the drawings, of which:

[0028] FIG. 1 is a cross-sectional, schematic view of an example insulating glass unit (IG unit or IGU);

[0029] FIG. 2 is an enlarged cross-section view of an end portion of the FIG. 1 example IG unit; and

[0030] FIG. 3 is a graph showing desiccant weight gain for different combinations of materials at 70% relative humidity.

DETAILED DESCRIPTION

[0031] Certain example embodiments of this invention relate to improved desiccant materials that can be used with insulating glass units (IG units or IGUs), IG units with such desiccant materials, and/or methods of making the same. One aspect of certain example embodiments relates to a non-rigid high moisture adsorption capacity desiccant material with fast draw down capability.

[0032] HL-5157, commercially available from H.B. Fuller, is a butyl matrix desiccant with a molecular sieve blended into it. This product allows for about 12.5% of moisture uptake by weight. The butyl component limits moisture diffusion to inner particles of desiccant (the molecular sieve). Other commercial desiccant matrix formulations may provide about 14.5% by weight moisture capacity. With respect to the HL-5157 product, it has been found that increasing the molecular sieve to try and improve desiccant capacity results in changes of the material properties and makes it hard to extrude, while also changing the properties of the matrix once cool.

[0033] The conventional thinking is that a much higher capacity desiccant material (e.g., greater than 15% by weight, more preferably greater than 50% by weight, and approaching or even surpassing 100% by weight) would be desirable in that it could lead to lower material cost, reduced desiccant material volume, adequate capacity during a 20-25-year (or possibly longer) lifetime, and enhanced post-production dew point reduction in IG units. Thus, according to the conventional wisdom, it would be desirable to improve upon these current desiccant materials such that new materials are provided, e.g., with a maximum capacity that is about 2-5 times higher than what is currently being employed. Further, it would be desirable to have high-efficiency desiccant materials that can be either extruded or held together in some way. Desiccant beads and molecular sieves alone might be considered ideal and have minimal diffusion issues (at least when this conventional wisdom is applied), but the materials might be disadvantageous because they could break loose or dislodge during manufacturing (e.g., when the spacer system frame is cut) unless an additional remediation technique is employed (which could involve, for example, using a coating to keep the desiccant material together, without adversely affective diffusive effects).

[0034] In general, it would be desirable to have a desiccant material that captures water molecules and avoids bigger atoms and molecule capture. Oxygen, argon, and nitrogen capture, for example, can be problematic, e.g., because that might involve capture of the desired environment within the cavity of the IG unit (e.g., capture of atoms contributing to the 80% Ar-20% air or 90% Ar-10% air environments that are typical for IG units, or the capture of capture of atoms of the inert gas that partially or completely fills the cavity of the IG unit). Similarly, as discussed in greater detail below, molecular sieves are known to be problematic when reactive gasses are used (e.g., CO₂ capture is a known issue for molecular sieves). A 3A molecular sieve material will have a pore diameter of 3 angstroms and a bulk density, whereas a 13x molecular sieve material will have a pore diameter of 10 angstroms. A material with a nominal pore opening of 3

angstroms, or a blend with a high proportion of 3A material and a low proportion of 13x material, might be desirable if conventional wisdom were being applied. Moisture adsorption by weight of at least 20%, more preferably at least 50%, and still more preferably at least 75%, similarly might be desirable if conventional wisdom were being applied. There preferably would be no outgassing of any volatile compounds (e.g., volatile organic compounds) below 70 degrees C. Other desirable properties might include, for example:

[0035] A non-rigid profile capable of bending profile to 12" diameter with little force;

[0036] Extrudable, injectable, or otherwise locatable in the cavity of a continuous linear box spacer system assembly as the box spacer system is manufactured (e.g., such that it maintains its shape with little or no slump at extrusion temperatures, has a small profile, and can be placed within cavities of the sizes noted above);

[0037] Not friable for at least one year, such that dust, particles, beads, and/or small pieces do not easily flake or break loose from bulk extrusion;

[0038] Cuttable, sliceable, or susceptible to punch-out at room temperature with tool steel hardware or the like;

[0039] No appreciable moisture diffusion limitation;

[0040] Active for 20-25+ years;

[0041] Able to withstand long term -50 degree C. to +70 degree C. temperature cycling without degradation or any other side effects;

[0042] Low cost; and/or

[0043] Lacking in harmful and/or regulated components, e.g., such that the material is useable in common manufacturing areas of production facility with no special personal protective equipment, air handling requirements, or the like.

[0044] Different categories of materials may be used to provide desiccants that behave as desired. These categories include, for example, alternative desiccant materials, hybrid desiccant materials, and polymer-based desiccants/binders. Each is discussed, in turn, below.

[0045] First, alternative desiccant materials basically comprise primary desiccant materials that are physically and/or chemically modified to have improved moisture adsorption properties. Typically, these materials will be in homogeneous powders or particles. Modified MgSO₄, for example, may be used in this regard. Modifications may include, for example, modifying particle size (e.g., in the case of MgCl₂), dehydrating materials for use, and/or the like.

[0046] Second, hybrid desiccant materials basically are composite materials that include a primary desiccant material with other materials such as binders or clay to improve the overall properties of the composite for specific purposes. Suitable hybrid materials may be achieved by combining calcium chloride or metal oxide compounds which are able to absorb high amount of moisture with binders or clay to support and retain the desiccant materials when they are turned to liquid after the moisture adsorption.

[0047] Third, the polymer-based desiccants/binders category refers to any polymer-based material that can be used either as a desiccant by itself, or act as a binder for any other desiccant material. Moldable polymer based desiccants or at least binders that improve the desiccant properties may be used in this regard.

[0048] The addition of salts or other common materials to a standard desiccant matrix material, has been found to yield improved (higher) moisture capacity, which may be beneficial for IG units. These materials may be added in addition to, or take the place of, standard molecular sieves in certain example embodiments. Materials that may be used in this regard include salts and other materials such as, for example, $MgCl_2$, $CaCl_2$, CaO , $MgSO_4$, and/or the like.

[0049] FIG. 3 is a graph showing desiccant weight gain for different combinations of materials at 70% relative humidity. The "+10%" label in FIG. 3 indicates that x grams of HL-5157 material had 0.1x grams of the other listed material added to it. As can be seen from FIG. 3, at 70% relative humidity, HL-5157 from H.B. Fuller had a "baseline" weight gain of 4.8%. The introduction of an added 10% $MgSO_4$ provided a modest increase to 5.1% by weight and, likewise, the introduction of an added 10% $CaCl_2$ provided an increase to 6.5% by weight. In contrast, the introduction of an added 10% $MgCl_2$ provided a superior result, namely, an increase to 18.2% by weight.

[0050] In the IG unit space, the conventional thinking is that reaching saturation of desiccant will cause the air around the desiccant to saturate as well (or at the very least be at equilibrium with saturation of the particular material), and saturated air implies condensing or at the edge of condensing at a given temperature. Thus, when focusing on performance at high humidity values, one would rule-out or discount solutions making use of conventional desiccant matrix materials with added salts or other materials such as those listed above. Moreover, standard IG unit desiccants claim moisture capacities at relative humidity values substantially greater than the conditions typically found within IG units. This artificially raises the perceived moisture capacity and can exclude other potential materials for consideration as use in desiccant materials, e.g., for complementing a desiccant matrix and/or for at least partially replacing an existing molecular sieve. Indeed, prior work has ruled out solutions including $MgCl_2$, for example, even though it did increase the capacity of the base desiccant matrix, because liquid water could develop, which would undermine the point of its inclusion.

[0051] The inventors have recognized, however, that failure typically starts at 15-20% relative humidity in an insulating glass unit. Thus, gauging failure at high humidity levels (like the 70% relative humidity value used in FIG. 3) and setting targets for 75% or more are not really relevant to typical use cases. In this sense, gauging failures at 60% relative humidity might make sense in the packaging and other contexts, but testing at a much lower relative humidity would produce results at a much more realistic level suitable for IG applications. At lower relative humidity values, however, different materials behave differently. Thus, it is possible to attain desirable performance with a different spectrum of materials in certain example embodiments.

[0052] The inventors have further recognized that testing in an environment with 10-20% relative humidity, more preferably 10-15% relative humidity would yield data most relevant to typical IG unit applications. In certain example embodiments, an environment created by a $LiCl$ and/or KOH salt solution may be used when blending and/or testing desiccant matrix and sieve replacement materials. Doing so creates a humidity of 11% (which accords with the European EN 1279 series specifications), which is similar to the relative humidity level observed at the end of life of a typical

IG unit. It therefore may serve as an appropriate test in some instances. It will be appreciated that other salt solutions or the like may be used to create mixing and/or testing environments that may be used in connection with certain example embodiments. With this lower relative humidity environment, which in some ways is more appropriate for (or better tailored to) IG unit applications, concerns with development of liquid water at very high adsorption should be mitigated. It will be appreciated that the desiccant material, in whole or in part, can be formed and/or tested in an environment at a relative humidity of 10-20% in some instances. In other instances, the desiccant material, in whole or in part, can be formed and/or tested in an environment at higher and/or lower relative humidity ranges. Moreover, even though the desiccant material, in whole or in part, can be formed and/or tested in such relative humidity ranges, it will be appreciated that the absorption may occur over much broader ranges of relative humidity in use.

[0053] Certain example embodiments thus provide a desiccant material comprising a desiccant matrix and a molecular sieve replacement material (e.g., $MgCl_2$, $CaCl_2$, CaO , $MgSO_4$, and/or the like) formed for adsorption at a relative humidity of 10-20%. This desiccant material may further comprise a molecular sieve different from the molecular sieve replacement material, or the molecular sieve replacement material may completely replace any other molecular sieve. In certain example embodiments, the molecular sieve replacement material may comprise 5-25% of the desiccant material, more preferably 10-20% of the desiccant material. The remainder of the material may be the desiccant matrix material in certain example embodiments. In certain example embodiments, the molecular sieve replacement material may amount to 5-25% of the other desiccant material, more preferably 10-20% of the desiccant material. The desiccant matrix material may be HL-5157 or some other existing material in certain example embodiments.

[0054] In certain example embodiments, some or all of the design goals as noted above may be used with the desiccant material designed for use with lower relative humidity values. For example, such a desiccant material may be blended into a paste or other material that can be injected, extruded, or otherwise easily provided in an IG unit spacer system (e.g., as the spacer system is being formed and/or as the substrates are being connected to one another). The desiccant material may be provided in a body of the spacer system, and the spacer system may be any of the spacer systems described in the patent publications listed above. As another example, there preferably would be no outgassing of any volatile compounds (e.g., volatile organic compounds) below 70 degrees C. Other desirable properties might include, for example, the material being not friable for at least one year, such that dust, particles, beads, and/or small pieces do not easily flake or break loose from bulk extrusion; being active for 20-25+ years; etc.

[0055] Including a matrix material in a desiccant does slow the adsorption rate of the desiccant. This is sometimes thought of as a negative effect in accelerated testing, as forced diffusion of water into the system may outpace the matrix until it is given enough recovery time to catch up. However, the inventors have realized that real-world diffusion is relatively slow, so this concern is alleviated. Moreover, the slow property of the matrix can be a positive for

manufacturing process, as sensitivity to open time during processing is reduced and/or the amount of open time can be increased.

[0056] The use of salts or other common materials, such as $MgCl_2$, together with or in place of standard molecular sieves, will enable alternate, typically reactive gases such as CO_2 , to be used IG units as well, without causing the IG units' volumetric decrease. Indeed, common materials, such as $MgCl_2$, do not react with CO_2 . Thus, the use of such materials opens the pathway to using reactive gasses within IG unit cavities. CO_2 and some other reactive gasses are not compatible with molecular sieves so, in such cases, desiccant materials may lack molecular sieve materials altogether. Shade applications are particularly sensitive to contamination from even very small particles. Indeed, it has been found that the presence of particles of about 5 microns in IG unit cavities can inhibit shade operations. Thus, fully capturing materials and, accordingly desiccant material selection, may be particularly important in such applications. Certain example embodiments aim to capture particles having a diameter or major dimension of at least 10 microns, more preferably at least 8 microns, and still more preferably at least 5 microns. Moreover, the take-up of IG unit atmosphere into the desiccant causes the pressure in the IG unit pressure cavity drops, and the IG unit can visibly collapse. And even if it does not collapse, the lower pressure can create higher driving forces for seal diffusion. With CO_2 for example, collapse can occur quite quickly.

[0057] The ability to provide a reactive gas such as CO_2 may be useful for providing electronic components in the cavity of the IG unit, e.g., because the CO_2 or other reactive gas may enable advantageous electrical properties to be realized. CO_2 and other reactive gasses are helpful in some electrical applications because they essentially insulate against electrical arcing. SF_6 gas helps stay below the ionization threshold and has been used, but CO_2 may be advantageous compared to SF_6 in some instances because CO_2 still has a fairly high ionization threshold, is readily available, is low cost, and provides good insulation/a good U-value which potentially enables the IG units to be used for a variety of different applications including for exterior window applications. Electrically-powered components that may be included in the cavity include, for example, lighting elements such as LEDs or the like, Internet-of-Things (IoT) devices such as sensors and the like, electrostatically- and/or motor-driven dynamic shades, etc. In certain example embodiments, the cavity may be filled with up to 80%, up to 90%, or even up to 100%, with a reactive gas such as CO_2 .

[0058] An electrostatically-driven dynamic shade may include, for example, a dynamically controllable shade interposed between the first and second substrates of the IG unit. The shade may include a first conductive layer provided, directly or indirectly, on the interior major surface of the first substrate. A shutter includes at least one polymer substrate, first and second conductive coatings, and first and second dielectric layers. The at least one polymer substrate is extendible to a shutter closed position and retractable to a shutter open position. The first and/or second conductive coatings are electrically connectable to a power source that is controllable to set up an electric potential difference to create first electrostatic forces to drive the at least one polymer substrate to the shutter closed position. Details regarding dynamic shade construction can be found in, for example, U.S. Pat. Nos. 8,982,441; 8,736,938; 8,134,112;

8,035,075; 7,705,826; and 7,645,977, as well as U.S. Publication No. 2020/0011120; the entire contents of each of which is hereby incorporated herein by reference. Additionally, or in the alternative, electrostatic forces can be used to cause retraction of the shade in certain example embodiments. In this regard, see U.S. application Ser. No. 16/779,927 filed on Feb. 3, 2020, the entire contents of which are hereby incorporated herein by reference.

[0059] It will be appreciated that the use of a desiccant matrix versus loose beads advantageously will reduce the likelihood of dust being produced within the IG unit cavity, which otherwise could be detrimental to functionality of an electronic device (and especially a dynamic shade). Certain example embodiments include a spacer housing a desiccant material including a desiccant matrix. However, different example embodiments may be provided in which a desiccant material lacking a desiccant matrix is provided in a spacer. Moreover, desiccant material with or without a matrix may be provided external to a spacer system in certain example embodiments. In this sense, a desiccant matrix is optional in different example embodiments, and there may be different ways to bind together desiccant material without the use of a matrix. For instance, desiccant can be provided as trapped beads in box spacers to be embedded in the foam formulation of foam spacers in certain example embodiments.

[0060] The IG units described herein may incorporate low-E coatings on any one or more of surfaces 1, 2, 3, and 4. As noted above, for example, such low-E coatings may serve as the conductive layers for shades. In certain example embodiments, the low-E coatings provided on surfaces 2 and 3 may be silver-based low-E coatings. Example low-E coatings are set forth in U.S. Pat. Nos. 9,802,860; 8,557,391; 7,998,320; 7,771,830; 7,198,851; 7,189,458; 7,056,588; and 6,887,575; the entire contents of each of which is hereby incorporated by reference. Low-E coatings based on ITO and/or the like may be used for interior surfaces and/or exterior surfaces. See, for example, U.S. Pat. Nos. 9,695,085 and 9,670,092; the entire contents of each of which is hereby incorporated by reference. These low-E coatings may be used in connection with certain example embodiments.

[0061] Antireflective coatings may be provided on major surfaces of the IG unit, as well. In certain example embodiments, an AR coating may be provided on one or more (or each) major surface(s) on which a low-E coating is not provided. Example AR coatings are described in, for example, U.S. Pat. Nos. 9,796,619 and 8,668,990 as well as U.S. Publication No. 2014/0272314; the entire contents of each of which is hereby incorporated by reference. See also U.S. Pat. No. 9,556,066, the entire contents of which is hereby incorporated by reference herein. These AR coatings may be used in connection with certain example embodiments.

[0062] The example embodiments described herein may be incorporated into a wide variety of applications including, for example, interior and exterior windows for commercial and/or residential application, skylights, doors, merchandizers such as refrigerators/freezers (e.g., for the doors and/or "walls" thereof), vehicle applications, etc.

[0063] Although certain example embodiments have been described in connection with IG units including two substrates, it will be appreciated that the techniques described herein may be applied with respect to so-called triple-IG units. In such units, first, second, and third substantially parallel spaced apart substrates are separated by first and

second spacer systems, and shades may be provided adjacent to any one or more of the interior surfaces of the innermost and outermost substrates, and/or to one or both of the surfaces of the middle substrate. Desiccant materials may be provided for one or both spacer systems in such arrangements.

[0064] Although certain example embodiments have been described as incorporating glass substrates (e.g., for use as the inner and outer panes of the IG units described herein), it will be appreciated that other example embodiments may incorporate a non-glass substrate for one or both of such panes. Plastics, composite materials, and/or the like may be used, for example. When glass substrates are used, such substrates may be heat treated (e.g., heat strengthened and/or thermally tempered), chemically tempered, left in the annealed state, etc. In certain example embodiments, the inner or outer substrate may be laminated to another substrate of the same or different material.

[0065] As used herein, the terms “on,” “supported by,” and the like should not be interpreted to mean that two elements are directly adjacent to one another unless explicitly stated. In other words, a first layer may be said to be “on” or “supported by” a second layer, even if there are one or more layers therebetween.

[0066] While the invention has been described in connection with what is presently considered to be the most practical and preferred embodiment, it is to be understood that the invention is not to be limited to the disclosed embodiment and/or deposition techniques, but on the contrary, is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims.

What is claimed is:

1. An insulating glass (IG) unit, comprising:
 - first and second substrates;
 - a spacer system interposed between the first and second substrates, the spacer system helping to maintain the first and second substrates in substantially parallel spaced apart relation to one another and to define a cavity between the first and second substrates; and
 - a desiccant material comprising a desiccant matrix and a molecular sieve replacement material formed for adsorption at a relative humidity of 10-20%, the desiccant material being located in a body of the spacer system.
2. The IG unit of claim 1, wherein the desiccant material further comprises a molecular sieve different from the molecular sieve replacement material.
3. The IG unit of claim 1, wherein the molecular sieve replacement material comprises 5-25% of the desiccant material or amounts to 5-25% of the other desiccant material.
4. The IG unit of claim 3, wherein the molecular sieve replacement material comprises 10-20% of the desiccant material or amounts to 10-20% of the other desiccant material.
5. The IG unit of claim 1, wherein the molecular sieve replacement material comprises a salt.
6. The IG unit of claim 1, wherein the molecular sieve replacement material comprises $MgCl_2$ and/or $CaCl_2$.
7. The IG unit of claim 1, wherein the cavity is at least partially filled with an inert gas.
8. The IG unit of claim 7, wherein the inert gas is argon.

9. The IG unit of claim 7, wherein up to 90% of the cavity is filled with the inert gas.

10. The IG unit of claim 1, wherein the cavity is at least partially filled with a reactive gas.

11. The IG unit of claim 10, wherein the cavity is at least partially filled with CO_2 .

12. The IG unit of claim 10, wherein the cavity is at least initially completely filled with the reactive gas.

13. The IG unit of claim 10, further comprising an electrically-powered device embedded in the cavity.

14. The IG unit of claim 13, wherein the electrically-powered device is a lighting element or an Internet-of-Things device.

15. A method of making an insulating glass (IG) unit, the method comprising:

having first and second substrates; and

connecting together the first and second substrates in connection with a spacer system interposed between the first and second substrates, the spacer system helping to maintain the first and second substrates in substantially parallel spaced apart relation to one another and to define a cavity between the first and second substrates;

wherein a desiccant material is provided in a body of the spacer system, the desiccant material comprising a salt and lacking a molecular sieve.

16. The method of claim 15, wherein the desiccant material further comprises a desiccant matrix containing the salt.

17. The method of claim 16, wherein the desiccant matrix is polymer based.

18. The method of claim 15, wherein the molecular sieve replacement material comprises $MgCl_2$ and/or $CaCl_2$.

19. The method of claim 15, wherein the molecular sieve replacement material comprises $CaCl_2$.

20. The method of claim 15, wherein the cavity is at least partially filled with an inert gas.

21. The method of claim 15, wherein the cavity is at least initially completely filled with the inert gas.

22. The method of claim 15, wherein the cavity is at least partially filled with a reactive gas.

23. The method of claim 22, wherein the cavity is at least partially filled with CO_2 .

24. The method of claim 22, wherein up to 90% of the cavity is filled with the reactive gas.

25. The method of claim 22, wherein an electrically-powered device is embedded in the cavity.

26. The method of claim 15, wherein the desiccant material is extruded or injected into the body of the spacer system.

27. The method of claim 15, wherein the desiccant material is provided to the body of the spacer system as the spacer system is being formed.

28. The method of claim 15, wherein the desiccant material is provided to the body of the spacer system as the first and second substrates are being secured to one another.

29. A desiccant material comprising a molecular sieve replacement material formed for adsorption at a relative humidity of 10-20%, the desiccant material being locatable in a body of the spacer system, the molecular sieve replacement material comprising a salt, the desiccant material lacking a molecular sieve.

30. The desiccant material of claim **29**, wherein the molecular sieve replacement material comprises 5-25% of the desiccant material or amounts to 5-25% of the other desiccant material.

31. The desiccant material of claim **29**, wherein the molecular sieve replacement material comprises MgCl_2 and/or CaCl_2 .

32. The desiccant material of claim **29**, wherein the molecular sieve replacement material is non-reactive with CO_2 .

33. The desiccant material of claim **29**, being extrudable into a body of a spacer system for an insulating glass unit.

34. The desiccant material of claim **29**, further comprising a matrix material.

35. The desiccant material of claim **34**, wherein the matrix material is polymer based.

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