

Glazed Solar Collectors

The invention concerns apparatus and method for collecting solar radiation and converting same to a form of energy suitable for space heating in buildings.

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The use of passive solar energy to heat buildings is well known. In September 1881, E S Morse obtained US Patent No. 246, 626 for “Warming and Ventilation Apartments by the Sun’s Rays” and the general concept of warming air beneath a glazing, before directing the warmed air to the interior of the building to provide space heating, has been
10 developed during the intervening years. So called “Trombe Walls” typically comprise a glazing which is arranged in spaced apart relation with a building wall to define a heated cavity. Air enters the cavity via one or more vents near its bottom and is warmed by solar radiation which causes it to rise and exit the cavity via a vent to the interior of the building.

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WO 2010/086126 discloses another approach to building heating using solar energy. In this document the solar collector comprises a collector panel which defines an at least partially enclosed space. The collector panel, known as a transpired solar collector, comprises energy absorbing sides, air-inlet openings connecting the outside environment
20 with the at least partly enclosed space and an air-outlet duct connected to the at least partly enclosed space. Solar energy is absorbed by the energy absorbing sides and this causes heating of air in the outside environment, in the immediate vicinity of the panel.

A negative pressure is applied to the air-outlet duct and this causes the warmed air to pass
25 through the air-inlet openings, through the at least partially enclosed space and out of the air-outlet duct, from where it is directed to the point of use in space heating, or heat storage. WO 2010/086126 also describes systems for storing and managing the heat derived from the panels.

30 The effectiveness of the apparatus described in WO 2010/086126 is affected by wind which disturbs the warmed air in the vicinity of the panel, before it passes through the inlet openings.

Chinese Utility Model No. eN 201517854 U describes another system in which air, warmed by solar radiation, is used for space heating. Again, a panel is disclosed, with holes through which warmed air passes and is recovered for building heating. The apparatus also includes a glazing, arranged in parallel spaced relationship with the panel so that air between the glazing and the panel is warmed by solar radiation before being passing through the holes. A glazing comprising glass having a high iron content is recommended because such glass absorbs solar radiation more effectively, better to heat the air between the glazing and the panel.

The requirement for ever improving means for collecting solar energy remains. The present invention provides such means, whereby solar energy is collected with a high degree of efficiency and made available for uses such as internal space heating in buildings or heat storage and management e.g., according to the methods described in WO 2010/086126.

According to the invention, apparatus for collecting solar energy comprises:

a cavity,

a glazing, arranged to allow solar radiation to pass therethrough and enter the cavity,

an inlet aperture, arranged to allow air to enter the cavity from an external environment and

an outlet aperture, arranged to allow air warmed by the solar radiation, to exit the cavity;

characterised in that the glazing comprises a coated glass.

The coating may comprises a low emissivity coating, a pyrolytically deposited fluorine doped tin oxide a titania coating or an antireflection coating.

In embodiments comprising a single glazing sheet, the coating is located on either the internal surface, or the external surface of the glass, relative to the cavity.

In one embodiment, the glazing comprises a major sheet and has integral glass sidewalls.

- 5 Two glazings may be employed, each glazing comprising a major sheet and two integral glass sidewalls, and the glazings being arranged to define the cavity therebetween.

The apparatus may include an Insulated Glazing Unit (IGU), said IGU comprising at least two glass sheets. The IGU may comprise two glass sheets wherein the coating is located
10 on surface #4 of the IGU. The coating on surface #4 of the IGU may comprise titania or pyrolytically deposited fluorine doped tin oxide.

Alternatively, the IGU may comprise two glass sheets wherein the coating is a low E coating located on surface #3 of the IGU. This coating may be the product of a sputter
15 deposition process and may comprise silver or a compound of silver.

Alternatively, the coating may be located on surface #1 of the IGU and may comprise an antireflection coating, a titania coating or a pyrolytically deposited fluorine doped tin
oxide.

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The IGU may include a glass sheet comprising a tinted glass. Typically, the tinted glass would have a composition comprising at least 0.15wt% iron.

The apparatus may include at least one sheet of glass comprises a low iron content glass,
25 having an iron content of less than 0.02wt%, preferably less than 0.015wt% most preferably less than 0.01wt%.

The apparatus may include a transpired solar collector arranged to divide the cavity into first and second regions, the first region being bounded by the glazing wherein the
30 collector comprises a sheet of material having a plurality of holes, the holes providing communication between the two regions,

and wherein the inlet aperture is arranged to allow air to enter the first region and the outlet aperture is arranged to allow air to leave the second region.

Where the apparatus includes a titania coating on the innermost glass surface relative to the cavity, means may be included for directing a flow of water on to said surface.

According to a second aspect of the invention, apparatus for collecting solar energy comprises:

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a cavity,

a glazing, arranged to allow solar radiation to pass therethrough and enter the cavity,

15 an inlet aperture, arranged to allow air to enter the cavity from an external environment and

an outlet aperture, arranged to allow air warmed by the solar radiation, to exit the cavity;

20 characterised in that the glazing comprises a low iron glass.

Preferably, the glass comprises less than 0.02wt% iron, more preferably less than 0.015wt% iron and even more preferably, less than 0.01wt% iron.

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The invention will now be further described using non-limiting examples, with reference to the attached figures in which:

Figures 1 – 3 illustrate various embodiments of the invention employing a single glazing on a simple undivided cavity;

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Figures 4 – 8 illustrate various embodiments of the invention employing a multiple glazing on a simple undivided cavity;

Figures 9 – 14 illustrate various embodiments of the invention in which the cavity is
5 divided by a transpired solar collector;

Figure 15 illustrates apparatus according to the invention in which a glazing having a ‘U’ shaped cross-sectional profile is employed;

10 Figure 16 illustrates apparatus employing a glazing having a ‘U’ shaped cross-sectional profile wherein the cavity is divided by a transpired solar collector and

Figures 17a and 17b illustrate embodiments wherein two glazings having a ‘U’ shaped cross-sectional profile are used to define the cavity.

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Figures 18 and 19 illustrate a test apparatus used to evaluate the performance of glazed solar collectors according to the invention both with and without a Transpired Solar Collector sheet;

20 Figure 20 shows the performance of various embodiments of the invention in terms of rise in air temperature achieved for a given solar radiation and

Figure 21 shows the improvement in performance over a simple uncoated glazed cavity that may be achieved by various embodiments of the invention.

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Referring to figure 1, a first embodiment of the invention includes a cavity 1 which is partly defined by a glazing 2. The cavity further comprises side walls (not shown) parallel to the plane of the page and may be arranged against the wall of a building which serves as another wall of the cavity. Alternatively, an insulated panel 3, which may be fixed to
30 the exterior of a building, may serve as the back wall of the cavity. Examples of insulated panels which might serve this purpose include Trisomet® 333 manufactured by Tata Steel.

During operation, cold air enters the cavity via a lower aperture 4, is warmed by solar radiation passing through the glazing and then exits cavity via an upper aperture 5. After exiting the cavity, the warmed air may be directed to the interior of a building to provide space heating or the heat may be extracted for storage or other use by means well known to persons skilled in the art.

Warming of the air in the cavity 1 is aided by the so-called greenhouse effect, whereby solar radiation passes through the glazing and is absorbed by the interior of the cavity to cause heating. The glazing is less transmissive to infrared radiation associated with this heating and hence inhibits heat loss. A low iron glass such as Pilkington OptiwhiteTM may be used for the glazing as this further reduces the amount of solar energy absorbed by the glass and facilitates transmission of energy to the cavity. Preferably, the low iron glass comprises <0.02wt% iron, more preferably <0.015wt% and most preferably <0.010wt%.

In various embodiments of the invention, a coating 6 is applied to the inner surface of the glazing.

In one embodiment, the coating 6 comprises a low emissivity (low E) coating (designated 6a in subsequent drawings) which reduces the transmission of infrared radiation. Thus loss of heat through the glazing, from within the cavity, is reduced.

The low E coating is preferably chosen to optimise the trade-off between solar gain and heat trapping by balancing transmission of solar radiation into the cavity against heat loss by infrared radiation from the cavity. In this connection, an optimum sheet resistance of between 15 and 30 ohm per square has been established. Pilkington K GlassTM is a low E glazing material suitable for use in this embodiment of the invention. K GlassTM comprises a fluorine doped tin oxide coating on a colour suppressing silicon oxycarbide coating.

In another embodiment the coating 6 may comprise a functional coating (designated 6b in subsequent drawings) such as titanium dioxide (titania). Titania coatings are known to

offer an antimicrobial effect via a photocatalytic effect, whereby highly reactive free radicals are generated from oxygen and moisture under the influence of ultraviolet radiation in (for example) sunlight. Inclusion of such a coating on the inner surface of the glazing causes decomposition of organic contaminants and killing of microorganisms to provide a purified air supply for the building.

Use of such a coating along with means for irrigating the inner surface of the glazing provides for easy cleaning of the inner glazing surface. Such irrigation means (not shown) typically comprises a water outlet such as a nozzle, array of nozzles or a pipe with one or more holes, connected to a water supply and arranged to direct a flow of water on to the coated surface.

The self-cleaning action is enhanced where a hydrophilic coating is used which causes water droplets to spread on the surface and run off easily.

Pilkington ActivTM is a titania-based self-cleaning glazing which serves in this embodiment.

In general, in all of the embodiments described herein, where a titania-based self-cleaning coating is used on a interior surface of the glass, relative to the cavity, such embodiments may optionally include means for irrigating said inner surface.

Referring to figure 2, in another preferred embodiment, a functional coating 6b is applied to the external surface of the glazing. For example, an antireflective coating increases the effectiveness of the device by increasing the amount of solar radiation which is transmitted through the glazing 2 to provide heading of air in the cavity 1. Pilkington OptiviewTM serves as a suitable glazing product in this embodiment.

Alternatively, the functional coating 6b could comprise a self-cleaning coating such as found on Pilkington ActivTM so that the exterior glass surface remains relatively free from contaminants that would otherwise inhibit transmission of solar radiation and adversely affect the visible appearance of the installation. Pilkington ActivTM also offers

anticondensation properties in this orientation as its hydrophilic properties cause water droplets which gather on the outer surface to spread and readily run off.

Anticondensation properties are also achieved using pyrolytically deposited fluorine doped tin oxide based coatings such as found in Pilkington K GlassTM or Energy AdvantageTM. These so-called 'hard coatings', which are deposited during the float glass manufacturing process, are highly stable and fused to the glass surface. This makes them suitable for applications where they are exposed to the external environment.

Referring to figure 3, the glazing could include coatings on both sides. The inner surface coating 6 could, for example be a low E coating or a titania coating. The coating 6b on the external surface could be a functional coating such as anticondensation, antireflective or self-cleaning. Preferably in this embodiment, the emissivity of the inner coating 6 is less than that of the outer coating 6b.

Referring to figure 4, the invention may include an insulated glazed unit (IGU) 7 of the type well known in the art and comprising two or more glazings 2, 8 held apart by spacers 9 to define a low thermal conductivity gap 10, typically containing air or another gas. In the embodiment shown, a coating 6 is shown on the innermost glass surface which, as in the previous embodiment (figure 1) might be a low E coating or a titania coating. By convention, the glass surfaces are numbered from #1 to #4, number 1 being the outermost (i.e. furthest from the building, contacting the external environment) so in figure 3, the coating 6 is shown on surface #4. When used in this specification, conventional numbers referring to the various glass surfaces are underlined in order to distinguish them from numerals used to identify features in the drawings.

Referring to figure 5, as an alternative to the arrangement shown in figure 3, a low E coating 6a may be located on an internal glass surface with the IGU.

In figure 5, the low E coating 6a is shown on surface 3. Since this surface is protected from the elements due to its location within the IGU, a so called 'soft coating' may be

used such as a silver-based sputtered coating of the type known in the art. Pilkington OptithermTM is an example of a product having such a coating.

Referring to figures 6 and 7, use of a multi-glazed IGU offers a number of options for the application of various coatings to the various surfaces. In figure 6, a functional titania coating 6b is shown on surface #4 along with a low E coating 6a on surface #. Thus, the benefits of both reduced heat loss and air purification are realised in a single embodiment.

In figure 7, a low E coating 6a is shown on surface 3 along with a functional coating 6b on surface #1. The functional coating 6b could *inter alia* be a titania coating; an antireflection coating or an anti-condensation coating.

Referring to figure 8, the invention may employ a sheet of tinted glass 2a as the inner sheet 1 of the IGU 7. Tinted glass may be realised as a glass having a higher iron content. Tinted glasses are well known to those skilled in the art and typically contain more than 0.15wt%Fe. The ratio of $\text{Fe}^{2+}/\text{Fe}^{3+}$ varies and other additives may also be varied. The tinted glass 2a absorbs more energy from the solar radiation causing it to become heated. This heat may be transferred to the air in the cavity 1 by re-radiation or conduction. The benefits of using a tinted glass are enhanced when used in conjunction with a low E coating 6a, particularly on surface #3, which inhibits re-radiation of the absorbed energy away from the cavity 1.

Apparatus according to the invention may also include a transpired solar collector comprising a perforated sheet, arranged to absorb energy from solar radiation and cause warming of the air in the vicinity of its surface.

Referring to figure 9, in one embodiment of the invention, the cavity is divided into two regions 1a and 1b by a transpired solar collector panel 11. The collector panel 11 is arranged to absorb energy from solar radiation causing its temperature to rise. This, in turn gives rise to heating of the air in the immediate vicinity of the collector.

A negative pressure is applied to region 1b of the cavity, via outlet aperture 5, by means not shown (for example an extractor fan) and this causes warmed air to pass through the perforations (holes) in collector 11 from region 1a to region 1b. The warmed air is then directed as described previously for the functions of space heating or heat storage.

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Inclusion of the glazing 2 enhances the effectiveness of the apparatus by the greenhouse effect as previously described. As before, a low iron glass such as Pilkington OptiwhiteTM is preferred as this increases the effectiveness of the glazing in this regard. In addition, the glazing prevents dispersal of the warmed air by wind so that it is able to pass through the transpired solar collector panel 11 undisturbed.

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The single glazed system illustrated in figure 9 preferably includes a coating 6 on the glazing. In one embodiment a low-E coating is used, further to reduce heat loss by radiation from the cavity region 1b to the external environment. In another embodiment, the coating 6 comprises a titania coating to provide purified air as described previously.

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The transpired solar collector may also be used in conjunction with an IGU. As before, the IGU offers a number of options in terms of surfaces to which various coatings might be applied.

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Figure 10 illustrates embodiments of the invention in which a transpired solar collector panel 11 is combined with an IGU. Surface #4 of the IGU bears a coating 6, which in one embodiment is a low E coating. In another embodiment, coating 6 comprises a titania coating.

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In the embodiment illustrated by figure 11, a low E coating 6a is applied to surface #3 of the IGU.

In figure 12, an embodiment is shown which employs a transpired solar collector panel 11; a low E coating 6a is applied to surface #3 of the IGU 7 to reduce heat loss and a titania coating 6b is applied to surface #4 in order to provide purified air.

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In figure 13, the IGU 7 has a low E coating on surface #3 and a functional coating 6b on surface #1. Functional coating 6b could be an antireflective coating, a titania coating or an anticondensation coating.

- 5 Referring to figure 14, the invention may employ a transpired solar collector panel 11 and an IGU 7 in which one of the glass sheets 2a is tinted. As before, the tinted glass has a greater ability to absorb solar radiation which may then be transferred to the air in cavity as heat and a low E coating is preferably applied to surface #3 of the IGU 7, to reduce radiation of heat away from the cavity.

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Referring to figure 15, in another variant of the invention, a glazing is employed which has a 'U' shaped profile, that is it comprises a major sheet 2a (which corresponds to the flat glazing 2 shown in previous embodiments) along with integral glass sidewalls 2b. Such a glazing, along with the wall of the building or insulating panel 3 defines the cavity
15 within which air is warmed by solar radiation.

Utilisation of a glazing having integral glass sidewalls allows for more solar energy to enter the cavity. Such a glazing may be provided as Pilkington ProfilitTM linear channel glass.

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Referring to figure 16, the 'U' profiled glazing may be used in conjunction with a transpired solar collector panel 11 which, as in previous embodiments, divides the cavity into regions 1a, where the air is warmed, and 1b, from where the warmed air is drawn after passing through the transpired solar collector.

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Referring to figure 17a and 17b, the cavity 1 may be defined by two glazing sheets having a 'U' profile. In use, the major sheet 2a of one glazing sheet faces the external environment and allows solar radiation to enter the cavity while the major sheet 3a of the other glazing provides the back wall of the cavity.

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Glazing systems employing Pilkington ProfilitTM in this manner are commercially available.

As in other embodiments, various surfaces of the glazings may be coated. For example, inner surface of major sheet 3a may include a low e coating. Also, use of a low iron glass will facilitate greater transmission of solar radiation to the cavity. Pilkington ProfilitTM is commercially available in a low e glass (Pilkington OptiwhiteTM).

Example 1

Referring to figures 18, apparatus used to test the effectiveness of various embodiments of the invention comprised: a glazed cavity assembly as generally illustrated in figures 1 – 8, further provided with air inlet and outlet ducts 12 and 13 respectively, a fan 14 located in the outlet duct and arranged to draw air through the cavity 1 and a thermocouple 15 arranged to measure the temperature of the air after it passed through the cavity 1.

Figure 19 shows a similar arrangement to that in figure 18, except that a glazed cavity with transpired solar collector as generally illustrated in figures 9 – 14 was being tested.

During testing, a plurality of assemblies as illustrated in figures 18 and 19, and each with a different surface coating 6, were arranged side by side with the glazing facing substantially in the direction of sunlight.

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N.B. In figures 18 and 19, the coated surface 6 is shown on the ‘interior’ of the cavity but these figures are examples only and in some cases arrangements were used where the coated surface was on the ‘exterior’.

25 The air flow was maintained at a linear velocity of about 1m/s which, for the apparatus used, equates to a volumetric flow of about $3.3 \times 10^{-3} \text{ m}^3/\text{s}$.

A comparison of the air temperature, as measured by thermocouple 15, with the ambient (inlet) air temperature provides a measure of the effectiveness of the glazed cavity for warming air.

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Table 1 shows the coating stacks associated with each of the coatings used (all thicknesses in nm). The coated stacks were tested on a simple glazed cavity (figure 18) and data were also obtained using an unglazed transpired solar collector and a glazed solar collector having uncoated soda-lime silica glass (i.e. as illustrated in figure 19 but with no coating 6).

Product	SiCO	SiO ₂	SnO ₂	SiO ₂	SnO ₂ :F
K Glass on Pilkington Optiwhite™	70	0	0	0	350
TEC6	0	20 ± 5	25 ± 3	25 ± 3	660 - 720
TEC10	0	0	25 ± 3	25 ± 3	380 -420
TEC15	0	0	25 ± 3	25 ± 3	340
Anticondensation	0	15	17 ± 3	30 ± 3	210

Table 1: Description of various coated products tested on glazed solar collector.

- Figure 20 shows the air temperature rise obtained for each of the solar collector arrangements indicated. The data show that even the combination of an uncoated glazing with the transpired solar collector produces a heating effect that is significantly greater than that offered by either of these features alone. The uncoated glazing offers some benefit by collecting and storing solar energy by a straightforward ‘greenhouse’ effect but also protects the Transpired Solar Collector from the effects of ambient wind. As previously noted, warmed air, in the vicinity of the Transpired Solar Collector (in cavity 1a of, e.g. figure 9), may be dispersed by the wind before passing through the Transpired collector, when a glazing is not present.
- However, a much greater benefit is obtained by use of a coated glazing.

The Pilkington K Glass™ on Optiwhite™ produced the most significant increase in air temperature. Without wishing to be bound by theory, it is believed that these coatings showing best performance offer the optimum compromise between the need to allow solar radiation to pass therethrough and enter the cavity, and the need to retain the heat in

the cavity once it has been captured. (N.B. TEC 15 R refers to the TEC 15 product being used in 'reverse orientation' i.e. the coated surface was on the outside of the cavity).

Example 2

- 5 Referring to figure 21, a further experiment was performed to compare the performance of a coated single glazing; a double glazed unit having a coating on surface #3 and an unglazed Transpired Solar Collector, with that of an uncoated glazed solar collector, having no transpired collector. The upper plot shows the performance of the double
10 glazed simple cavity (figure 18 with double glazed unit); the middle plot shows that of the single glazed simple cavity (figure 18) and the lower plot shows the performance of the unglazed Transpired Solar Collector.

- The horizontal axis in figure 21 represents temperature gain achieved by an uncoated glazed solar collector having no transpired solar collector panel (i.e. a glazed cavity). The
15 vertical axis represents the temperature gain achieved by each of the configurations described at the same point in time as the corresponding value on the horizontal axis was measured. Thus, the greater the slope of the graph, the better the performance of the configuration in question.

- 20 The coating used on both the single and double glazed cavities was an anticondensation coating produced by Pilkington Group Limited, whose composition is also indicated in table 1.

- Figure 21 shows that all of these configurations provide superior performance to an
25 uncoated glazed collector (by virtue of the positive slopes of all plots); a single coated glazed cavity provides superior result to an unglazed Transpired Solar Collector and a further increase, of about 6%, when the cavity is double glazed.

Example 3

- 30 Table 2 below summarises a further set of experiments performed using various embodiments of the invention.

Test Number	Airflow Ducting	Average Temp Increase	Average Irradiance	Efficiency	Glazing
Series 1					
1	0.3	23.7	850	0.19	K Glass OW #3 DGU
2	0.57	23.7	850	0.37	K Glass OW #3 DGU
3	0.62	27.7	850	0.47	22 ohm OW #3 DGU
4	0.7	18.9	850	0.36	22 ohm OW #3 DGU
5	1.03	15.4	850	0.43	K Glass S OW #3 DGU (glazed without TSC)
6		9.6	850	0.00	
7	1.09	19.2	850	0.57	22 ohm OW #4 DGU (glazed with TSC)
8	1.14	11.4	850	0.35	22 ohm OW #4 DGU (wide gap)
Series 2					
1	0.3	15.2	621	0.17	K Glass OW #3 DGU
2	0.57	14.8	621	0.31	K Glass OW #3 DGU
3	0.62	5.4	621	0.36	22 ohm OW #3 DGU
4	0.7	12.9	621	0.34	22 ohm OW #3 DGU

5	1.03	9.9	621	0.38	K Glass S OW #3 DGU (glazed without TSC)
6		8.7	621	0.00	
7	1.09	14.2	621	0.58	22 ohm OW #4 DGU (glazed with TSC)
8	1.14	9.5	621	0.40	22 ohm OW #4 DGU (wide gap)

(Additional Data:

Ducting diameter	0.075	0.075
vol flow at 1m/s	0.004415625	0.004415625
density of air	1.2	1.2
mass of air flow	0.00529875	0.00529875
Power required to raise temp by 1C	5.3305425	5.3305425
specific heat capacity of air	1.006	1.006
area of solar collector panel	0.23	0.23)

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#3, #4 etc = surface 3, surface 4 etc;

DGU = double glazed unit;

OW = Optiwhite™

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Table 2 further illustrates the effect of the invention in providing heated air for space heat heating and heat storage.

Numbers 5 and 7 of each series illustrate the improvement that can be achieved by a combination of a coated glazing and a transpired solar collector panel, as compared with a coated glazing only. In both series, the coated glazed Transpired Solar Collector (number 7) achieved greater temperature increases and efficiencies than the corresponding glazing without transpired solar collector panel (number 7).

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In this regard it should be noted that the K Glass S OW #3 DGU and the 22 ohm OW #4 DGU have been shown to be similar in performance, so the differences between numbers 5 and 7 are attributed to the presence or absence of the transpired solar collector panel. (OW 22 ohm is an anticondensation coating on Pilkington OptiwhiteTM).

Claims

1. Apparatus for collecting solar energy comprising:

5 a cavity,

a glazing, arranged to allow solar radiation to pass therethrough and enter the cavity,

10 an inlet aperture, arranged to allow air to enter the cavity from an external environment
and

an outlet aperture, arranged to allow air warmed by the solar radiation, to exit the cavity;

15 characterised in that the glazing comprises a coated glass.

2. Apparatus according to claim 1, wherein the coating comprises a low emissivity
coating.

20 3. Apparatus according to claim 2, wherein the coating comprises pyrolytically deposited
fluorine doped tin oxide.

4. Apparatus according to claim 1, wherein the coating comprises a titania coating.

25 5. Apparatus according to claim 3 or 4, wherein the coating is located on the internal
surface of the glass, relative to the cavity.

6. Apparatus according to claim 3 or 4, wherein the coating is located on the external
surface of the glass, relative to the cavity.

30 7. Apparatus according to claim 1, wherein the coating comprises an antireflection
coating.

8. Apparatus according to claim 1, comprising an Insulated Glazing Unit (IGU), said IGU comprising at least two glass sheets.
9. Apparatus according to claim 8, wherein the IGU comprises two glass sheets and the
5 coating is located on surface 4 of the IGU.
10. Apparatus according to claim 9, wherein the coating comprises titania.
11. Apparatus according to claim 9, wherein the coating comprises pyrolytically
10 deposited fluorine doped tin oxide.
12. Apparatus according to claim 8, wherein the IGU comprises two glass sheets and the coating is a low E coating located on surface 3 of the IGU.
- 15 13. Apparatus according to claim 12, wherein the coating is the product of a sputter deposition process.
14. Apparatus according to claim 13, wherein the coating comprises silver or a compound of silver.
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15. Apparatus according to claim 8, wherein the coating is located on surface 1 of the IGU.
16. Apparatus according to claim 15, wherein the coating comprises an antireflection
25 coating.
17. Apparatus according to claim 15, wherein the coating comprises a titania coating.
18. Apparatus according to claim 15, wherein the coating comprises pyrolytically
30 deposited fluorine doped tin oxide.

19. Apparatus according to claim 8, wherein at least one glass sheet comprises a tinted glass.

20. Apparatus according to claim 19, wherein the tinted glass has a composition
5 comprising at least 0.15wt% iron.

21. Apparatus according to any preceding claim, wherein at least one sheet of glass
comprises a low iron content glass, having an iron content of less than 0.02wt%,
preferably less than 0.015wt% most preferably less than 0.01wt%.

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22. Apparatus according to any of claims 1 – 7, wherein the glazing comprises a major
sheet and has integral glass sidewalls.

23. Apparatus according to any preceding claim, wherein the cavity is divided into first
15 and second regions by a transpired solar collector, the first region being bounded by the
glazing,

said collector comprising a sheet of material having a plurality of holes, the holes
providing communication between the two regions,

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and wherein the inlet aperture is arranged to allow air to enter the first region and the
outlet aperture is arranged to allow air to leave the second region.

24. Apparatus according to claim 4 or 10, or claim 23 when dependent on either of claims
25 4 or 10, and further comprising means for directing a flow of water on to the titania
coated glass surface.

25. Apparatus according to claim 22, comprising two glazings, each glazing comprising a
major sheet and two integral glass sidewalls, the glazings arranged to define the cavity
30 therebetween.

26. Apparatus for collecting solar energy comprising:

a cavity,

a glazing, arranged to allow solar radiation to pass therethrough and enter the cavity,

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an inlet aperture, arranged to allow air to enter the cavity from an external environment
and

an outlet aperture, arranged to allow air warmed by the solar radiation, to exit the cavity;

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characterised in that the glazing comprises a low iron glass.

27. Apparatus according to claim 26, comprising glass comprises less than 0.02wt% iron.

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28. Apparatus according to claim 27, comprising glass comprises less than 0.015wt%
iron.

29. Apparatus according to claim 28, comprising glass comprises less than 0.01wt% iron.