by adding to the encapsulant, a UV stabilizer, a UV absorber, or a combination of an absorber and a stabilizer, which may be added to improve the durability against UV rays.

[0007] However, in the case of a ultraviolet absorber, the light in the vicinity of a ultraviolet region cannot be incident into a solar cell, and thus the overall initial output of a solar cell module may be undesirably lowered. In addition, in order to improve insulation or induce moisture capture, when inorganic particles such as silica or magnesium hydroxide are introduced, the durability of the encapsulant may be more or less improved, but light absorption of the solar cell may be disturbed due to scattering or reflection of the sunlight incident into the front surface of the solar cell. As such, when a plurality of functional additives are added to solve the above problems, the durability of the encapsulant may be improved, but the overall output of a solar cell or solar cell module may be lowered.

[0008]

DESCRIPTION OF EXAMPLES

TECHNICAL PROBLEM

[0009] To solve the above problems, an objective of the present disclosure is to provide a solar conversion material capable of improving the photocurrent conversion efficiency of a solar cell.

[0010] Another objective of the present disclosure to provide a solar cell encapsulant, and a solar cell having high durability while having excellent photocurrent conversion efficiency.

[0011]

SOLUTION TO PROBLEM

[0012] To achieve an objective of the present disclosure, the present disclosure provides a solar wavelength conversion material comprising a luminescent aluminum hydroxide precursor.

[0012a] In an aspect, the present disclosure refers to a solar wavelength conversion material comprising luminescent aluminum hydroxide having ultraviolet absorption

and visible photoluminescence characteristics.

[0013] According to an example, the aluminum hydroxide precursor is preferably any one of aluminum monoacetate, aluminum triacetate, aluminum diacetate,

triethyl aluminum, trimethyl aluminum, aluminum alkoxide, diethyl aluminum chloride, aluminum sulfate, aluminum cyanide, aluminum nitrite, aluminum carbonate, aluminum sulfite, aluminum hydroxide , aluminum oxide, aluminum chlorate, aluminum sulfide, aluminum chromate, aluminum trichloride, aluminum perchlorate, aluminum nitrate, aluminum permanganate, aluminum hydrogen carbonate, aluminum phosphate, aluminum oxalate, aluminum hydrogen phosphate, aluminum thiosulfate , aluminum chlorite, aluminum hydrogen sulfate, aluminum dichromate, aluminum bromide, aluminum hypochlorite, aluminum chloride hexahydrate, aluminum dihydrogen phosphate, aluminum phosphite, aluminum potassium sulfate dodeca hydrate, aluminum bromate, aluminum nitride, or derivatives thereof.

[0014] According to an example, the solar wavelength conversion material preferably includes an $Al(OH)_3$, AlOOH, $5Al_2O_3 \cdot 2H_2O$, or Al_2O_3 structure.

[0015] According to an example, the luminescent aluminum hydroxide preferably has a size in a range of 1 nm to 1000 μm.

[0016] According to an example, the luminescent aluminum hydroxide preferably has a porous structure.

[0017] According to an example, the solar wavelength conversion material preferably further comprises a lanthanide ion or a derivative containing same.

[0018] According to an example, the lanthanide ion is preferably capable of emitting light in a near-infrared, ultraviolet, or visible light wavelength region.

[0019] According to an example, a precursor of the near-infrared luminescent lanthanide ion is preferably one or more selected from Yb (ytterbium), Nd (neodymium), Er (erbium), Ho (holmium), Tm (thulium), and derivatives containing same.

[0020] According to an example, the lanthanide ion precursor preferably contains an element having an emission wavelength in the visible light wavelength region.

[0021] According to an example, the lanthanide ion or the derivative containing same is preferably included in an amount of 0.001 to 10 parts by weight on the basis of 100 parts by weight of the aluminum hydroxide precursor.

[0022] According to an example, the solar wavelength conversion material preferably further comprises an aromatic ring compound or a derivative

thereof.

[0023] According to an example, the aromatic ring compound or the derivative

thereof is preferably located within 10 nm from the aluminum hydroxide precursor or aluminum hydroxide derived therefrom, or is preferably formed by a covalent bond.

[0024] According to an example, the aromatic ring compound is preferably one or more of an aromatic hydrocarbon in which only carbons and hydrogens are bonded together, an aromatic heterocyclic compound in which some of the carbon atoms forming a ring are substituted with oxygen, nitrogen, or sulfur atoms, other than carbon, or a derivative in which some of hydrogens are substituted with functional groups in the aromatic hydrocarbon and aromatic heterocyclic compound molecules.

[0025] According to an example, the aromatic ring compound is preferably one or more of furan, benzbenzofuran, isobenzbenzofuran, pyrrole, indole, isoindole, thiophene, benzbenzothiophene, imidazole, benzimidazole, purine, pyrazole, indazole, oxazole, benzoxazole, oxazole isoxazole, benzoxazole isoxazole, thiazole, benzbenzothiazole, benzbenzene, naphthalene, anthracene, pyridine, quinoxaline, acridine, pyrimidine, quinazoline, pyridazine, cinnoline, phthalazine, 1,2,3-triazine, 1,2,4-triazine, 1,3,5-triazine and derivatives thereof.

[0026] According to an example, the particle size of the solar wavelength conversion material is preferably in the range of 0.5 nm to 500 μm.

[0027] According to an example, the maximum absorption wavelength of the solar wavelength conversion material is 200 nm to 500 nm, preferably 300 to 450 nm.

[0028] According to an example, the maximum emission wavelength of the solar wavelength conversion material is preferably 450 nm to 1100 nm.

[0029] To achieve another objective of the present disclosure, the present disclosure provides a solar cell encapsulant comprising the solar wavelength conversion material according to the present disclosure.

[0029a] In another aspect, the present disclosure refers to a solar cell encapsulant comprising a resin having a solar wavelength conversion material dispersed therein, wherein the solar wavelength conversion material is the solar wavelength conversion material as defined above.

[0030] According to an example, the encapsulant is preferably in the form of a film having a thickness of 100 μm or less.

[0031] According to an example, the encapsulant is preferably EVA

(ethylene vinyl acetate), POE (polyolefin elastomer), cross-linked polyolefin (PO), TPU (thermal polyurethane), PVB (polyvinyl butyral), silicone, silicone/polyurethane hybrid, or ionomer.

[0032] According to an example, the solar wavelength conversion material is preferably contained in an amount of 0.0001 to 10 parts by weight, preferably 1 to 10

parts by weight, on the basis of 100 parts by weight of the resin of the encapsulant.

[0033] To achieve another objective of the present disclosure, the present disclosure provides a solar cell comprising the solar wavelength conversion material or the solar cell encapsulant, according to the present disclosure.

[0033a] In yet another aspect, the present disclosure refers to a solar cell comprising a solar wavelength conversion material located between an encapsulant on a front surface thereof where sunlight is incident and an interface of the solar cell, wherein the solar wavelength conversion material is the solar wavelength conversion material as defined above.

[0034] According to an example, the solar wavelength conversion material is preferably coated on the front surface of the solar cell or on the back surface of the encapsulant on the front surface of the solar cell.

[0035] According to an example, the coating is preferably spray coating or screen coating.

[0036] According to an example, the solar cell encapsulant is preferably EVA (ethylene vinyl acetate), POE (polyolefin elastomer), cross-linked polyolefin (PO), TPU (thermal polyurethane), PVB (polyvinyl butyral), silicone, silicone/polyurethane hybrid, or ionomer.

[0037] In addition, in a preferred example of the present disclosure, the encapsulant according to the present disclosure is laminated on the front and rear surfaces of the solar cell, glass is laminated on the front surface of the encapsulant located on the front surface of the solar cell, and a back sheet is laminated on the back surface of the encapsulant located on the back surface of the solar cell.

[0037a] In yet another aspect, the present disclosure refers to a solar cell wherein the encapsulant as defined above is laminated on the front and rear surfaces of the solar cell, glass is laminated on the front surface of the encapsulant located on the front surface of the solar cell, and a back sheet is laminated on the back surface of the encapsulant located on the back surface of the solar cell.

[0038]

ADVANTAGEOUS EFFECTS OF DISCLOSURE

[0039] When a solar module is manufactured by uniformly dispersing a solar wavelength conversion material having ultraviolet absorption and visible photoluminescence characteristics in a resin, not only ultraviolet blocking effect by ultraviolet absorption but also a down-conversion effect of visible photoluminescence can be expected, thereby manufacturing a solar module with an increased output along with durability.

[0040] In addition, the durability of an encapsulant can be further improved by the heat-resistant, moisture-resistant effects due to aluminum hydroxide materials capable of absorbing heat and moisture.

[0041] Therefore, a solar module including an encapsulant in which a solar wavelength conversion material having such a photoluminescence characteristic is

dispersed can prevent a decrease in output due to long-term outdoor exposure by increasing long-term durability, which assists in solar energy generation.

[0042] In addition, the solar wavelength conversion material according to the present disclosure can emit one or more photons from ultraviolet light having low photocurrent conversion efficiency of a solar cell to visible and near-infrared light wavelength regions having high photocurrent conversion efficiency, thereby maximizing the efficiency of a solar cell.

[0043] Moreover, the solar wavelength conversion material according to the present disclosure introduces an aromatic ring compound and/or a lanthanide ion in the step for synthesizing luminescent aluminum hydroxide to further increase absorbance in the ultraviolet region, thereby enabling effective down-conversion, and at the same time to improve the durability of the solar cell, thereby lowering the power generation cost of the solar cell and ensuring long-term output.

[0044] When the solar wavelength conversion material is coated on the front side of the solar cell or the back side of the encapsulant on the front side of the solar cell, the efficiency of the solar cell can be increased. When the material is directly coated on the solar cell, down-conversion is induced, thereby improving the output.

[0045] In addition, when the solar wavelength conversion material is located at the interface between the encapsulant and the solar cell, the increased photovoltaic current due to an anti-reflective coating effect, and the anti-PID (potential induced degradation) effect of a solar energy module due to trapping of Na+ ions generated from the tempered glass of the module, and the anti-LeTID (light and elevated temperature induced degradation) effect due to UV blocking and heat dissipation properties, can also be expected.

[0046]

BRIEF DESCRIPTION OF DRAWINGS

[0047] FIG. 1 is a cross-sectional schematic view of an encapsulant in which luminescent aluminum hydroxide particles are dispersed, a solar photovoltaic (PV) cell including same, and a solar module.

[0048] FIG. 2 is a schematic diagram showing the principle of aluminum hydroxide photoluminescence for ultraviolet absorption and visible and near-infrared