

Description

This invention relates to a mulching film for repelling insects, which is effective for repelling insects harmful to various crops and other plants by covering the ground of plantation during the summer season and for promoting the lowering of the underground temperature and for preventing the propagation of weeds. More particularly, it relates to a laminate mulching film which comprises a reflective film layer having a reflective peak at a wavelength of less than $0.4\ \mu\text{m}$ and a reflective spectrum with a ratio R_A/R_B of not less than 1.4 wherein R_A is the ultraviolet peak reflectance and R_B is the visible light reflectance at a wavelength of $0.5\ \mu\text{m}$, and a black film layer containing carbon black.

A mulching film is usually used for the purpose of maintaining the moisture in the soil, controlling the underground temperature and preventing a loss of fertilizer components. During the summer season mulching is effective for maintaining the moisture in the soil and preventing a loss of fertilizer components, but the underground temperature is unfavorably raised. This is not desirable for the plants and further causes the problem of a significant propagation of weeds.

The most popular mulching film is a transparent polyethylene film, but when this mulching film is used in the summer season, the underground temperature raises too much due to the transmission of sunlight and the weeds propagate too significantly. Hence it is not suitable for crop culture. Besides, although a black mulching film is effective for the inhibition of weeds, it absorbs the sunlight well and causes a raise in the underground temperature. Hence, it is not suitable for lowering the underground temperature.

In order to improve the above drawbacks, it has been proposed to use as a mulching film suitable for the summer season a white mulching film containing titanium dioxide or a silver polyethylene film containing aluminum powder, but these mulching films are still not satisfactory due to an insufficient lowering of the underground temperature or an insufficient effect in the prevention of the propagation of weeds. Thus, there is not known any mulching film satisfying both requirements.

In some crop cultures, there are used films obtained by depositing aluminum or by laminating an aluminum foil on a polyethylene film. When these films are used in practice, the aluminum deposition or aluminum foil is occasionally peeled off or oxidized and torn to tatters during the use. Besides, they are expensive. Accordingly, these films are not commonly used. Moreover, a white and black laminate mulching film has also been proposed (cf. Japanese Utility Model Publication (Kokoku) No. 38369/1980), but it is still insufficient in lowering the underground temperature in the summer season, while it is effective for the prevention of the propagation of weeds.

It is also known that the above mulching films are somewhat effective for the prevention of various insects harmful to the crop culture, such as thrips (e.g. *Thrips palmi*), aphides (e.g. *Aphis gossypii*, *Mizus persiae*), fruit flies (e.g. *Zeugodacus cucurbitae*), *Aulacophora femoralis*, but they are not so effective for repelling other noxious insects.

Under these circumstances the present inventors have intensively searched for an improved mulching film suitable for crop cultures in the summer season, which is effective for lowering the underground temperature and the prevention of the propagation of weeds and further for repelling insects harmful to crops such as thrips (e.g. *Thrips palmi*) and aphides (e.g. *Aphis gossypii*, *Mizus persiae*). This object has been achieved by the surprising finding that a film having a reflective peak at a wavelength of less than $0.4\ \mu\text{m}$ and a reflective spectrum with a ratio R_A/R_B of not less than 1.4 wherein R_A is the ultraviolet peak reflectance and R_B is the visible light reflectance at a wavelength of $0.5\ \mu\text{m}$ is remarkably effective for repelling noxious insects, and that when the film is laminated with a black film layer containing carbon black which can completely absorb the light from the reflective film, there can be obtained a laminate film which is excellent in lowering the underground temperature and in preventing the propagation of weeds.

Fig. 1 shows a perspective view of one embodiment of the mulching film of this invention. Fig. 2 shows a perspective view of another embodiment of the mulching film of this invention. Fig. 3 to 5 show a sectional view of these mulching films, respectively. In these figures, the symbols have the following meaning:

1: A reflective film layer containing an inorganic compound, 2: a black film layer containing carbon black, 3: a transmission aperture, 4: a transmission aperture produced by fusing perforation, 5: a heat sealed area, and 6: an air layer.

Fig. 6-a and Fig. 6-b each show a graph of ultraviolet peak reflectance and visible light reflectance respectively at a wavelength of 0.2 to $0.8\ \mu\text{m}$ of the films produced in the Examples of this invention and in the Reference Examples for the comparison.

This invention provides a mulching laminate film having excellent effects in lowering the underground temperature and repelling insects, which comprises a reflective film layer having a reflective peak at a wavelength of less than $0.4\ \mu\text{m}$ and a reflective spectrum with a ratio R_A/R_B of not less than 1.4 wherein R_A is the ultraviolet peak reflectance and R_B is the visible light reflectance at a wavelength of $0.5\ \mu\text{m}$ and a

black film layer containing carbon black.

The starting resins used for the film of this invention include all kinds of conventional thermoplastic resins. Suitable examples of those resins are ethylene homopolymer or copolymers such as low-density polyethylene, high-density polyethylene, ethylene-butene-1 copolymers, ethylene-4-methylpentene-1 copolymers, ethylene-vinyl acetate copolymers, ethylene-acrylic acid copolymers, ethylene-methyl methacrylate copolymers, ethylene-vinyl acetate-methyl methacrylate copolymers, ethylene ethyl acrylate copolymers, etc.; polypropylene; vinyl chloride resins; and the like. These resins may be used alone or in combination of two or more thereof.

The reflective film layer of this invention can be prepared by incorporating into the resin a specific inorganic compound having a ultraviolet reflectance at a wavelength of less than $0.4\ \mu\text{m}$ and a ratio (n_A/n_B) of the refractive index of the inorganic compound [n_A] and the refractive index of the resin [n_B] of not less than 1.2, preferably not less than 1.5. The inorganic compound used in this invention includes any kinds of compounds satisfying the above-mentioned conditions. Specific examples are titanate compounds such as potassium titanate, calcium titanate, magnesium titanate, barium titanate, strontium titanate and lithium titanate; zirconium compounds such as zirconium silicate and zirconium oxide. Among these compounds, potassium titanate, barium titanate, zirconium silicate and zirconium oxide are particularly preferable in view of the excellent light reflective characteristics and weatherability of the film.

The inorganic compounds may be used in the form of powders or whiskers. The form of whiskers is preferred in view of the excellent strength and light reflective characteristics of the film. When the ratio of R_A/R_B is less than the above lower limit, the film is unfavorably less insect-repelling.

The resins used in the reflective film layer and the black film layer may be the same or different. The coloring agent for the black film layer is preferably carbon black.

The laminate film of this invention can be prepared, for example, by the following steps.

A thermoplastic resin composition and at least one of the inorganic compound in the form of a powder or whisker are mixed and kneaded in a conventional Banbury mixer, two roll kneader or extruding kneader, where the resin is molten and thoroughly mixed with the inorganic compound. The kneaded composition thus prepared and a resin composition containing carbon black are formed into a two layer film by a co-extruding film processing method, that is, by extruding them separately from two extruders provided with a two layer extruder die. The two layer film may also be prepared by treating separately an inorganic compound-containing resin composition and a carbon black-containing resin composition with a conventional processing machine as usually used in blown film processing, T-die film processing or calender processing, or by a two color tubular film processing method, that is, by extruding separately each resin composition from two extruders provided with a specific two color blown film die wherein one half of the periphery of the film tube is composed of the inorganic compound-containing resin composition and the other half thereof is composed of the carbon black-containing resin composition. Among these methods, the two color tubular film processing method is preferable because a step of piling up the two film layers as mentioned below is not required.

The inorganic compound-containing film and the carbon black-containing film as prepared above are piled up and then the films are adhered by subjecting them to heat sealing or with a hot melt adhesive to give the desired two layer laminate film.

The inorganic compound-containing film and the carbon black-containing film are each preferably made in the most suitable thickness, taking into consideration profitability and easy handling. The preferred thickness of each film is 5 to $35\ \mu\text{m}$. The whole thickness of the co-extruded or adhered film is preferably in the range of 10 to $75\ \mu\text{m}$.

The amount of the inorganic compound in the reflective film layer is not particularly critical but may preferably be in the range of 0.5 to 30% by weight, more preferably 5 to 30% by weight, based on the whole weight of the inorganic compound-containing film layer in view of high near-infrared and ultraviolet reflections. The amount of carbon black used for the black film layer is preferably in the range of 2 to 10% by weight based on the whole weight of the carbon black-containing film layer in view of the complete adsorption of sunlight.

The co-extruded or adhered two layer laminate film has preferably transmission apertures having a diameter of 0.3 to 10 mm and an aperture ratio of 0.1 to 5%, by which the lowering of the underground temperature is more effectively achieved.

The transmission apertures can be made at the same process line as in the film processing or by separately passing another line for perforation. The apertures can be made by a conventional method, such as punching or needling with hot needles. In the case of an adhered two layer laminate film, the needling with hot needles is preferable because the perforation and adhesion of the area surrounding the apertures can simultaneously be effected. The transmission apertures are preferably formed in a diameter of 0.3 to 10

mm, more preferably 0.5 to 3 mm, and an aperture ratio of 0.1 to 5%. When the diameter and ratio are lower than the lower limits of the above ranges, the lowering of the underground temperature is not sufficiently effected, and on the other hand, when they are over the upper limits, it exhibits unfavorably less inhibition of the propagation of weeds, while the lowering of the underground temperature is well effected.

The mulching film of this invention can reflect well the near-infrared rays by the reflective film layer and thereby the raising of the underground temperature is well inhibited, and can absorb completely sunlight by the black film layer and thereby can prevent well the propagation of weeds. Moreover, the reflective film layer has ultraviolet and visible light reflectivity at a specific wavelength and hence exhibits a repelling effect against various harmful insects such as thrips (e.g. Thrips palmi) and aphides (e.g. Aphis gossypii, Mizus persiae), and is particularly useful for a flat land culture of lettuce which is usually cultured at a cool high land in the summer season, and for a culture of cucumber which is cropped both in summer and in autumn, and for a culture of late-raising tomatoes and spinach.

When the mulching film has transmission apertures, it shows excellent lowering effects on the underground temperature owing to the promotion of the permeation of air through the apertures. In the case of the two layer laminate film prepared by the heat sealing method or needling with hot needles, an intermediate air layer is provided between the two film layers, and hence, the property of lowering the underground temperature is more improved in comparison with the two layer film prepared by the co-extrusion method.

This invention is illustrated by the following examples and reference examples but should not be construed to be limited thereto.

In the examples and reference examples, the measurement of the underground temperature, propagation of weeds and the insect - repelling test were carried out in the following manner.

The film was applied for mulching onto a ridge (width : 1 m, length : 10 m, height : 20 cm). A thermometer was set at 5 cm depth from the surface of the ground in order to measure the underground temperature.

After 30 days from the mulching, the state of the propagation of weeds was observed by checking the state of weeds on the ridge.

The insect-repelling effect was measured by counting the number of Thrips palmi or Aphis gossypii, (per 40 leaves) in a culture of kidney beans for 30 days within the mulching.

Example 1

A mixture of an ethylene-butene-1 copolymer [density : 0.921 g/cm³, melt index (MI) : 2 g/10 min., refractive index (n_B) : 1.51] (100 parts by weight), potassium titanate whiskers (Tismo® D, K₂O-6TiO₂, manufactured by Otsuka Kagaku K.K., refractive index (n_A) : 2.4) (20 parts by weight) and glycerine monostearate (as a dispersing agent) (0.3 part by weight) is kneaded in a 5 liter Banbury mixer at a resin temperature of 150 - 160°C for 10 minutes and then extruded from an extruder to prepare granular pellets (the resulting composition is hereinafter referred to as "Resin Composition A").

The same ethylene-butene-1 copolymer (100 parts by weight) as used above, carbon black (5 parts by weight) and glycerin monostearate (as a dispersing agent) (0.1 part by weight) are kneaded and extruded in the same manner as described above. The resulting granular pellets are referred to as "Resin Composition B".

The Resin Composition A and Resin composition B obtained above are separately processed with a two layer film blowing apparatus provided with two extruders and two layer dies at a melting zone temperature of 220°C and a die temperature of 200°C. The Resin Composition A and Resin Composition B are molten and adhered within the two layer dies to give a two layer laminate film. The film thus obtained has a thickness ratio of Resin Composition A/Resin Composition B layers of 1/1 and a total thickness of 30 μ m. The film has a ratio (R_A/R_B) of an ultraviolet peak reflectance (R_A) and a reflectance at a wavelength of 0.5 μ m (R_B) of 1.71.

The physical properties and activities of the film were tested with the Resin Composition A at the outside of the laminate film. The results are shown in Table 1.

Example 2

In the same manner as described in Example 1 except that a low density polyethylene (density : 0.923 g/cm³, MI : 1.5 g/10 min., refractive index (n_B) : 1.51, 100 parts by weight), potassium titanate whiskers (Tismo® D, K₂O-6TiO₂, manufactured by Otsuka Kagaku K.K., refractive index (n_A) : 2.4, 10 parts by weight) and glycerin monostearate (as a dispersing agent, 0.3 part by weight) are kneaded and pelletized, there are obtained granular pellets (Resin Composition C). Besides, by using the same low-density polyethylene,

carbon black and glycerin monostearate, granular pellets (Resin Composition D) are prepared likewise. The Resin Compositions C and D are processed in the two layer film blowing apparatus in the same manner as in Example 1 to prepare a two layer film.

The physical properties and activities of the film were tested, and the results are shown in Table 1.

Example 3

The two layer film as prepared in Example 2 is perforated with hot needles to give a two layer perforated film having an aperture diameter of 1.5 mm and an aperture ratio of 0.2%.

The physical properties and activities of the film were tested, and the results are shown in Table 1.

Example 4

Ethylene-butene-1 copolymer [density : 0.921 g/cm³, MI : 2 g/10 min., refractive index (n_D) : 1.51] (100 parts by weight), potassium titanate whiskers (Tismo® L, K₂O·6TiO₂, manufactured by Otsuka Kagaku K.K., refractive index (n_A) : 2.3) (5 parts by weight) and glycerine monostearate (as a dispersing agent) (0.3 part by weight) are mixed in a 5 liter Banbury mixer at a resin temperature of 150 - 160°C for 10 minutes and pelletized with an extruder to give granular pellets (the resulting composition is hereinafter referred to as "Resin Composition E").

The same ethylene-butene-1 copolymer (100 parts by weight) as used above, carbon black (5 parts by weight) and glycerin monostearate (as a dispersing agent) (0.1 part by weight) are kneaded and extruded in the same manner as described above. The resulting granular pellets are referred to as "Resin Composition F".

The Resin Composition E and Resin composition F obtained above are separately processed with a two color blown film processing machine provided with two extruders and two color dies at a melting zone temperature of 220°C and a die temperature of 200°C to give a two color film wherein one half of the periphery of the tubular film is composed of Resin Composition E and the remaining half of the periphery is composed of Resin Composition F. The film thus obtained has a total thickness of 15 μ m.

The tubular film is folded at the contacting line of the layer of Resin Composition E and the layer of Resin Composition F and the layers are piled up.

The film is then perforated with a fusing perforation machine with an aperture ratio of 0.2% (aperture diameter : 1.5 mm) and the areas surrounding each apertures are heat-sealed to give a perforated laminate film. In the film thus obtained, the areas surrounding apertures are heat-sealed and other areas are merely piled, and hence, the latter areas include an air layer.

The physical properties and activities of the film were tested. The results are shown in Table 1.

Example 5

In the same manner as described in Example 1 except that zirconium silicate (A-PAX®, ZrO₂ : 65.7 wt.% and SiO₂ : 33.3 wt.%, manufactured by Kinsei Kogyo K.K., refractive index (n_A) : 1.8, 20 parts by weight) is used instead of potassium titanate whiskers, there is obtained a two layer laminate film.

The physical properties and activities of the film were tested, and the results are shown in Table 1.

Example 6

In the same manner as described in Example 1 except that powdery potassium titanate having an average particle size of 2.5 μ m (K₂O·6TiO₂, manufactured by Kubota Tekko K.K., refractive index (n_A) : 2.4, 20 parts by weight) is used instead of potassium titanate whiskers for the preparation of Resin composition A, there is prepared a two layer film.

The physical properties and activities of the film were tested, and the results are shown in Table 1.

Example 7

In the same manner as described in Example 1 except that zirconium oxide (EP zirconium oxide, ZrO₂ : 99.5 wt.% and SiO₂ : 0.2 wt.% manufactured by Daiichi Kigenso Kagaku K.K., 20 parts by weight) is used instead of potassium titanate whiskers for the preparation of Resin Composition A, there is prepared a two layer film.

The physical properties and activities of the film were tested, and the results are shown in Table 1.

Reference Example 1

Using the Resin Composition B as used in Example 1 alone, there is prepared a single layer film having a thickness of 30 μm with a conventional blown film processing machine.

The physical properties and activities of this film were tested. The results are shown in Table 1.

Reference Example 2

Using an ethylene-butene-1 copolymer (density : 0.921 g/cm³, MI : 2 g/10 min.), there is prepared a transparent film having a thickness of 30 μm with a conventional blown film processing machine.

The physical properties and activities of this film were tested. The results are shown in Table 1.

Reference Example 3

In the same manner as described in Example 1 except that powdery titanium dioxide (rutile type, 20 parts by weight) is used instead of potassium titanate used in the preparation of Resin Composition A, there is prepared a two layer laminate film.

The physical properties and activities of the film were tested. The results are shown in Table 1.

Reference Example 4

In the same manner as described in Example 1 except that powdery aluminium (20 parts by weight) is used instead of potassium titanate used in the preparation of Resin Composition A, there is prepared a two layer laminate film.

The physical properties and activities of the film were tested. The results are shown in Table 1.

As is clear from Table 1, the mulching films of this invention have superior effects in the inhibition of a raise in the underground temperature and in repelling insects in comparison with the conventional mulching films, and further, the mulching films of this invention also show excellent effects in the prevention of the propagation of weeds.

Table 1 (Physical properties and activities of the films)

Ex. No.	Light reflective properties				Underground temp.- lowering effect			Insect repelling effect		State of propaga- tion of weeds
	Ultraviolet reflective peak wave- length (μm)	Ultraviolet reflectance R_A (%)	Reflectance at wave- length 0.5 μm R_B (%)	R_A/R_B	Maximum temp. (°C)	Minimum temp. (°C)	Mean temp. (°C)	Thrips palml	Aphis gossypii	
Ex. 1	0.37	29	17	1.71	34.2	20.4	25.6	96	106	None
" 2	0.37	22	13	1.69	35.4	21.0	26.3	118	111	None
" 3	0.37	21	12	1.75	33.6	19.8	24.5	115	103	Almost none
" 4	0.38	16	10	1.60	31.8	18.9	23.0	107	119	Almost none
" 5	0.30	23	10	2.30	33.1	20.3	27.3	92	97	None
" 6	0.36	28	16	1.75	34.2	19.9	25.2	98	112	None
" 7	0.32	32	19	1.68	33.8	19.2	24.6	90	105	None

- to be continued -

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Table 1 (Continued)

Ex. No.	Light reflective properties				Underground temp.-lowering effect			Insect repelling effect		State of propagation of weeds
	Ultraviolet reflective peak wave-length (μm)	Ultraviolet reflectance R_A (%)	Reflectance at wave-length 0.5 μm R_B (%)	R_A/R_B	Maximum temp. ($^{\circ}\text{C}$)	Minimum temp. ($^{\circ}\text{C}$)	Mean temp. ($^{\circ}\text{C}$)	Thrips palmi	Aphis gossypii	
Ref. Ex. 1	-	-	-	-	42.6	21.5	28.7	261	258	Nore
" 2	-	-	-	-	47.1	22.3	31.5	332	234	Much
" 3	0.41	63	55	1.15	35.8	21.8	26.1	173	218	Nore
" 4	0.26	41	37	1.11	40.3	22.0	28.2	145	193	Nore
Control (No mulching)	-	-	-	-	39.7	20.0	27.2	565	611	Much propagation



Claims

1. A mulching film for lowering of the underground temperature and for repelling insects, which comprises
 - 5 - a reflective film layer having a reflective peak at a wavelength of less than $0.4\ \mu\text{m}$ and a reflective spectrum with a ratio R_A/R_B of not less than 1.4 wherein
 R_A = ultraviolet peak reflectance and
 R_B = visible light reflectance at a wavelength of $0.5\ \mu\text{m}$, and - a black film layer containing carbon black.
 2. The film according to claim 1, wherein the reflective film layer is a layer of a thermoplastic resin containing an inorganic compound.
 3. The film according to claim 2, wherein the inorganic compound is a titanate compound.
 4. The film according to claim 2, wherein the inorganic compound is a zirconium compound.
 5. The film according to claim 1, which is a laminate film prepared with a co-extruding film processing machine provided with a two layer extruding die.
 - 15 6. The film according to claim 1, which is a laminate film having transmission apertures of an aperture diameter of 0.3 to 10 mm and an aperture ratio of 0.1 to 5%.
 7. The film according to claim 1, which is an adhered two layer laminate film comprising a reflective film layer of a resin composition containing an inorganic compound and a black film layer and having transmission apertures of an aperture diameter of 0.3 to 10 mm and an aperture ratio of 0.1 to 5% which is prepared
 - 20 by subjecting a film obtained by piling up the reflective film layer and the black film layer to a fusing perforation, said adhered film being adhered at the area surrounding the apertures and having an intermediate air layer at other area.

25 Ansprüche

1. Eine Abdeckfolie zum Herabsetzen der Untergrundtemperatur und zur Abwehr von Insekten, enthaltend
 - 30 - eine reflektierende Folienschicht mit einem Reflexionsmaximum bei einer Wellenlänge von weniger als $0.4\ \mu\text{m}$ und einem Reflexionsspektrum mit einem Verhältnis R_A/R_B von mindestens 1,4, wobei
 R_A der maximale Reflexionsgrad im Ultraviolett-Bereich und
 R_B der Reflexionsgrad im sichtbaren Bereich bei einer Wellenlänge von $0.5\ \mu\text{m}$ ist und
 - eine schwarze Folienschicht, die Ruß enthält.
 2. Die Folie nach Anspruch 1, wobei die reflektierende Folienschicht eine Schicht aus einem thermoplastischen Harz ist, das eine anorganische Verbindung enthält.
 3. Die Folie nach Anspruch 2, wobei die anorganische Verbindung eine Titanatverbindung ist.
 4. Die Folie nach Anspruch 2, worin die anorganische Verbindung eine Zirkoniumverbindung ist.
 5. Die Folie nach Anspruch 1, welche als Schichtpreßstoff vorliegt, der mit einer Co-Extrusionsfolienmaschine mit einer Zweischichtenstrangpreßform hergestellt wurde.
 - 40 6. Die Folie nach Anspruch 1, welche einen Schichtpreßstoff darstellt, der Durchlaßöffnungen mit einem Durchmesser von 0,3 bis 10 mm und einem Öffnungsverhältnis von 0,1 bis 5% aufweist.
 7. Die Folie nach Anspruch 1, welche einen zweischichtigen Schichtpreßstoff darstellt, enthaltend eine reflektierende Folienschicht aus einem Harz, das eine anorganische Verbindung enthält, und eine schwarze Folienschicht und Durchlaßöffnungen mit einem Durchmesser von 0,3 bis 10 mm und einem Öffnungsverhältnis von 0,1 bis 5% aufweist, die hergestellt wurde, indem man eine Folie, die man durch Aufeinander-schichten der reflektierenden Folienschicht und der schwarzen Folienschicht erhalten hat, einer Schmelzperforation unterwirft, wobei die zusammenhaftenden Schichten an den Bereichen um die Öffnungen herum aneinander haften und in anderen Bereichen eine Luftzwischenschicht aufweisen.

50 Revendications

1. Un film de paillage pour abaisser la temperature du sous-sol et pour repousser les insectes, qui comprend
 - 55 - une couche de film réflecteur ayant un pic de réflexion à une longueur d'onde de moins de $0.4\ \mu\text{m}$ et un spectre de réflexion avec un rapport R_A/R_B non inférieur à 1,4 où
 R_A = pic de réflectance de l'ultraviolet et
 R_B = réflectance de la lumière visible à une longueur d'onde de $0.5\ \mu\text{m}$ et



- une couche de film noir contenant du noir de carbone.

2. Le film selon la revendication 1, selon lequel la couche de film réflecteur est une couche d'une résine thermoplastique contenant un composé inorganique.

3. Le film selon la revendication 2, selon lequel le composé inorganique est un composé titanate.

4. Le film selon la revendication 2, selon lequel le composé inorganique est un composé de zirconium.

5. Le film selon la revendication 1, qui est un film stratifié préparé à l'aide d'une machine de traitement du film par co-extrusion équipé d'une filière d'extrusion de deux couches.

6. Le film selon la revendication 1, qui est un film stratifié ayant des ouvertures de transmission d'un diamètre d'ouverture de 0,3 à 10 mm et un rapport d'ouverture de 0,1 à 5%.

7. Le film selon la revendication 1, qui est un film stratifié à deux couches comprenant une couche de film réflecteur d'une composition de résine contenant un composé inorganique et une couche de film noir et ayant des ouvertures de transmission d'un diamètre d'ouverture de 0,3 à 10 mm et d'un rapport d'ouverture de 0,1 à 5% qui est préparé en soumettant un film obtenu par empilage de la couche de film réflecteur et de la couche de film noir à une perforation par fusion, ledit film adhérent étant adhérent au niveau des surfaces entourant les ouvertures et ayant une couche d'air intermédiaire dans d'autres surfaces.