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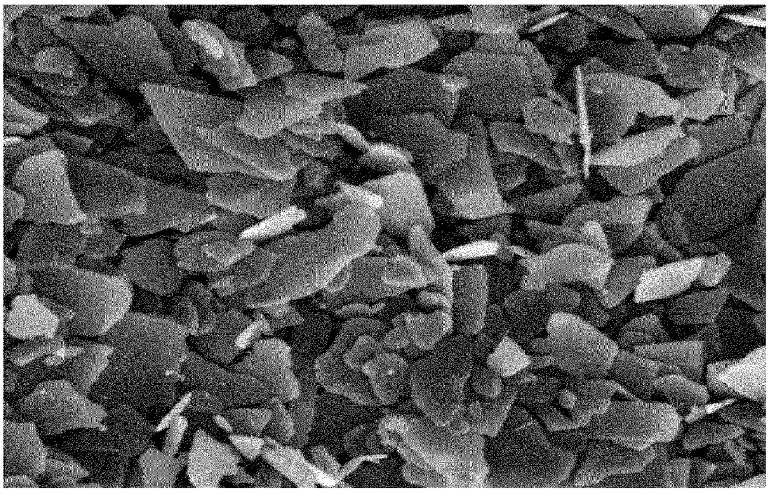
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[Continued on next page]

(54) Title: NACREOUS PIGMENT WITH HIGH CHROMA AND MULTIPLE COLORS AND METHOD OF PREPARING THE SAME

[Fig. 2]



(57) Abstract: The present invention relates to a nacreous pigment and a method of preparing the same. The nacreous pigment includes a flake substrate, a first metal oxide layer coated on the substrate, and an oxide layer coated on the first metal oxide layer and containing $MgO \cdot SiO_2$, and a second metal oxide layer coated on the oxide layer. The pigment exhibits high brightness, high chroma, high gloss, and multi-color effects.

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Description

Title of Invention: NACREOUS PIGMENT WITH HIGH CHROMA AND MULTIPLE COLORS AND METHOD OF PREPARING THE SAME

Technical Field

[1] The present invention relates to a nacreous pigment composed of multiple layers and, more particularly, to a technique for easily realizing a multi-color pigment, which includes alternating multiple layers with a low refractive index layer formed of $MgO \cdot SiO_2$ to provide various effects such as high brightness, high gloss-high chroma.

[2]

Background Art

[3] A nacreous pigment is composed of multiple layers, which includes a low refractive index layer and a high refractive index layer coated on a transparent matrix.

[4] In a conventional pigment, the low refractive index layer consists of SiO_2.

[5] Here, when the low refractive index layer has an excessively low thickness, the pigment exhibits low brightness and low gloss. Thus, the low refractive index layer formed of SiO_2 is thickly coated to improve brightness and gloss characteristics of the pigment. However, as the thickness of the low refractive index layer increases, the pigment tends to suffer cracking and can realize only a single color.

[6]

Disclosure of Invention

Technical Problem

[7] One aspect of the present invention is to provide a multi-color pigment, which includes alternating layers with a low refractive index layer formed of $MgO \cdot SiO_2$ to realize various effects such as high brightness, high gloss-high chroma to the multi-color pigment.

[8] Another aspect of the present invention is to provide a method of preparing a multi-color pigment, in which an added amount of $MgO \cdot SiO_2$ is increased to allow formation of the multi-color pigment without increasing the thickness of a low refractive index layer and to prevent defects such as cracking.

Solution to Problem

[9] In accordance with one aspect of the invention, a method of preparing a nacreous pigment includes: (a) preparing a suspension by mixing a flake substrate including at least one of synthetic mica, natural mica, glass, iron oxide flake, alumina flake and silica flake with de-ionized (DI) water to produce a flake mixture, followed by stirring

and dispersing the mixture, (b) forming a first metal oxide layer on a surface of the flake substrate by titrating a first soluble inorganic metal salt solution to the suspension, followed by hydrolyzing the first inorganic metal salt solution, (c) forming an oxide layer on a surface of the first metal oxide layer by titrating a soluble inorganic salt solution containing $MgO \cdot SiO_2$ to the suspension obtained by titration of the first inorganic salt solution, followed by hydrolyzing the inorganic salt solution, and (d) forming a second metal oxide layer on the surface of the oxide layer by titrating a second soluble inorganic metal salt solution to the suspension obtained by titration of the inorganic salt solution, followed by hydrolyzing the second inorganic metal salt solution.

[10] In accordance with another aspect of the invention, a nacreous pigment includes: a flake substrate; a first metal oxide layer coated on the substrate; and an oxide layer coated on the first metal oxide layer and containing $MgO \cdot SiO_2$; and a second metal oxide layer coated on the oxide layer.

Advantageous Effects of Invention

[11] According to exemplary embodiments, a method of preparing a nacreous pigment includes forming a low refractive index layer using $MgO \cdot SiO_2$, thereby providing high brightness and high gloss to the nacreous pigment with a low thickness.

[12] In addition, according to the embodiments, since there is no need to increase the thickness of the low refractive index layer in the pigment, the method ensures easy preparation of the pigment exhibiting high chroma and multi-color effects.

[13]

Brief Description of Drawings

[14] The above and other aspects, features and advantages of the invention will be more clearly understood from the following detailed description of exemplary embodiments taken in conjunction with the accompanying drawings, in which:

[15] Fig. 1 is a scanning electron microscope (SEM) micrograph of an SiO_2 layer of a conventional nacreous pigment, showing cracks formed therein; and

[16] Fig. 2 is a SEM micrograph of an $MgO \cdot SiO_2$ layer of a nacreous pigment according to an exemplary embodiment of the present invention.

[17]

Mode for the Invention

[18] Exemplary embodiments of the invention will now be described in detail with reference to the accompanying drawings. It should be understood that the present invention is not limited to the following embodiments and may be embodied in different ways, and that the embodiments are given to provide complete disclosure of the invention and to provide thorough understanding of the invention to those skilled in

the art. The scope of the invention is limited only by the accompanying claims and equivalents thereof. Like components will be denoted by like reference numerals throughout the specification.

[19] First, a method of preparing a nacreous pigment according to one exemplary embodiment will be described.

[20] The method according to the embodiment includes preparing a suspension, forming a first metal oxide layer, forming an $MgO \cdot SiO_2$ layer, and forming a second metal oxide layer.

[21]

[22] Preparation of suspension

[23] First, a suspension is prepared by mixing de-ionized (DI) water with a flake, which is used as a substrate and has a predetermined size, to produce a flake mixture, followed by stirring and dispersing the mixture.

[24] Here, the flake substrate has a lamellar shape and may have a particle size of 5 to 250 . If the particle size of the flake substrate is less than 5 , the flake substrate gradually becomes spherical with increasing coating thickness, as a substance is coated on the surface of the flake substrate. In other words, an aspect ratio of the coating decreases, causing scattering of light by diffuse reflection, so that the same color having the same index of refraction cannot be realized.

[25] On the contrary, if the particle size of the lamellar flake substrate exceeds 250 , the surface area of the substrate to be coated with a substance increases, making it difficult to constitute coating layers for realizing colors.

[26] As the flake substrate, at least one of synthetic mica, natural mica, glass, iron oxide flake, alumina flake, and silica flake may be used.

[27] Further, the flake substrate may be present in an amount of 5~20 percent by weight (wt%) in terms of solid content in the suspension.

[28] If the content of the solid flake substrate is less than 5 wt%, reaction for forming a subsequent oxide layer may not occur or may insufficiently occur. If the content of the solid flake substrate exceeds 20 wt%, reaction efficiency can deteriorate.

[29] After the suspension for the pigment is prepared, the suspension is heated to a temperature of 60~90. If the temperature of the heated suspension is less than 60, coating layers can be unevenly formed on the flake substrate and the size and shape of coated substances become very irregular. Further, if the temperature of the heated suspension exceeds 90, an intense reaction occurs, causing a rough coating layer to be formed on the flake substrate.

[30] If the coating layers of the pigment are unstable, the pigment does not exhibit high chroma. Thus, it is desirable to keep the temperature of the suspension within this range. In addition, the temperature range described above may be applied to all other

reactions for forming first and second metal oxide layers and an oxide layer described below.

[31]

[32] Formation of first metal oxide layer

[33] As described above, after preparing and heating the suspension, a first metal oxide layer is coated on a surface of the flake substrate by titrating a first soluble inorganic metal salt solution to the suspension, followed by hydrolyzing the first inorganic metal salt solution.

[34] Here, the inorganic metal salt may be composed of at least one selected from $SnCl_4$, $TiCl_4$, $TiOCl_2$, $TiOSO_4$, $FeCl_3$, $FeSO_4$, $SiCl_4$, $ZrOCl_2$, $Na_2O{\cdot}SiO_2{\cdot}5H_2O$, $MnCl_2$, $MgCl_2$, $AlCl_3$, $CoCl_2$, and mixtures thereof.

[35] Further, the first inorganic metal salt solution may be added dropwise to the suspension to allow hydrolysis of the inorganic metal salt solution.

[36] Here, the suspension may have a pH in the range of 1~9. If the suspension has a pH of less than 1, coating of the first metal oxide layer does not normally occur, and if the suspension has a pH exceeding 9, the coated substance has very uneven size and shape. As a result, the coating layer becomes very rough, causing deterioration in chroma of the pigment.

[37] In addition, after titration of the solution at a constant pH, the suspension is refluxed for 10 to 30 minutes.

[38] At this time, within this pH range, the suspension allows the first metal oxide layer to be coated in a ratio of 1~50% on the surface of the substrate, and reflux relieves impact relating to the pH during reaction while allowing the coating substance to be sufficiently coated on the surface of the substrate.

[39] Accordingly, if reflux is performed for less than 10 minutes, a sufficient coating ratio cannot be obtained and impact can be applied to the flake substrate, causing cracks. If reflux is performed over 30 minutes, the flake substrate can be broken or undergo separation of the coating layer therefrom during stirring.

[40]

[41] Formation of $MgO{\cdot}SiO_2$ layer

[42] With the first metal oxide layer coated on the surface of the flake substrate, the suspension is heated again to 60~90. Here, this temperature range is set to form an optimal coating layer, as described above.

[43] Then, an $MgO{\cdot}SiO_2$ layer is coated on a surface of the first metal oxide layer by titrating an inorganic salt solution containing $MgO{\cdot}SiO_2$ to the heated suspension, followed by hydrolyzing the inorganic salt solution. Herein, a coating layer formed by coating $MgO{\cdot}SiO_2$ alone or together with other oxides will be referred to as an oxide layer.

[44] Here, the inorganic salt solution may contain at least one selected from water glass, $MgCl_2$, silicate salt, $AlCl_3$, KCl_3, boron, and mixtures thereof.

[45] In this process, the suspension may have a pH of 4~14. If the pH of the suspension is less than 4, coating of the oxide layer does not normally occur, and the coated substance has very uneven size and shape, thereby causing deterioration in chroma of the pigment.

[46] In addition, after titration of the solution with the pH of the solution maintained constant, the suspension is refluxed for 30 to 60 minutes

[47] Here, the pH of the suspension may be adjusted to allow the oxide layer to be formed on the surface of the substrate in a coating ratio of 1~30% for a high chroma-high gloss pigment and in a coating ratio of 30~90T for a multi-color pigment.

[48] For the multi-color pigment, the coating ratio of the oxide layer in the pigment may increase up to three times that of the gloss pigment. Accordingly, the weight ratio of the oxide layer to the pigment may be different in the high gloss-high chroma pigment and than in the multi-color pigment.

[49] For the high gloss-high chroma pigment, the coating ratio of the oxide layer may be in the range of 5 to 10 wt% with respect to the total weight of the pigment to provide optimal performance. Namely, if the coating ratio of the oxide layer is less than 5 wt% with respect to the total weight of the pigment, the pigment exhibits relatively low gloss, and if the coating ratio of the oxide layer exceeds 10 wt%, the pigment exhibits relatively low chroma.

[50] In addition, for the multi-color pigment, the coating ratio of the oxide layer may be in the range of 5 to 35 wt% with respect to the total weight of the pigment to provide optimal performance. Namely, if the coating ratio of the oxide layer is less than 5 wt% with respect to the total weight of the pigment, the pigment exhibits a single color, and if the coating ratio of the oxide layer exceeds 35 wt%, the pigment exhibits a relatively low color-changing effect.

[51] Hence, although the above discussion refers to 5 to 35 wt% as an advantageous coating ratio of the oxide layer in the pigment, it should be understood that the invention is not limited thereto and that the coating ratio may be changed depending on the kind of substrate, coating substances, and coating thickness.

[52] As such, the oxide layer of the pigment according to the embodiment essentially consists of $MgO{\cdot}SiO_2$, and may further contain at least one selected from SiO_2, $MgO{\cdot}Al_2O_3$, $K_2O{\cdot}SiO_2$, Mg_2SiO_4, and mixtures thereof.

[53] Such an oxide layer serves as a low refractive index layer in the pigment and may prevent cracking, which occurs in a conventional pigment having a low refractive index layer formed only of SiO_2.

[54] Fig. 1 is a scanning electron microscope (SEM) micrograph of a SiO_2 layer of a con-

ventional nacreous pigment, showing cracks formed therein

[55] In Fig. 1, it can be seen that the SiO_2 layer, that is, the low refractive index layer, of the conventional pigment is not densely formed and cracks are formed at the center of the layer.

[56] On the contrary, the $MgO{\cdot}SiO_2$ layer, that is, the low refractive index ratio, of the pigment according to the embodiment does not suffer from such a problem. One example of the $MgO{\cdot}SiO_2$ layer of the pigment according to the embodiment will be described.

[57] Fig. 2 is a SEM micrograph of an $MgO{\cdot}SiO_2$ layer of a nacreous pigment according to an exemplary embodiment of the invention.

[58] In Fig. 2, it can be seen that $MgO{\cdot}SiO_2$ layer of the pigment according to the embodiment is densely and uniformly formed without cracking.

[59] As such, use of the $MgO{\cdot}SiO_2$ layer facilitates adjustment of the thickness of the low refractive index layer in the pigment and provides high gloss, high chroma and multi-color effects to the pigment.

[60] As described above, the nacreous pigment according to the embodiment of the invention essentially consists of the transparent thin flake substrate, the first metal oxide layer coated on the transparent flake substrate, and the oxide layer coated on the first metal oxide layer and containing $MgO{\cdot}SiO_2$.

[61]

[62] Formation of second metal oxide layer

[63] In this embodiment, to protect the oxide layer while improving characteristics of the pigment such as high gloss, a second metal oxide layer is coated on the oxide layer by the same process as that of forming the first metal oxide layer.

[64] Then, the suspension having the second metal oxide layer is filtered, cleaned using de-ionized water, dried and remaining matter is then burnt and screened, thereby providing a final nacreous pigment according to the embodiment.

[65] According to the embodiment, the nacreous pigment has an alternating seven-layer structure, which includes a high refractive index layer and a low refractive index layer on either side of the transparent substrate, thereby exhibiting various characteristics such as high gloss, high chroma, excellent multi-color effects, and the like.

[66] Since such characteristics of the nacreous pigment are exhibited depending on the presence of the $MgO{\cdot}SiO_2$ layer, high gloss, high chroma and multi-color effects depending on use of the oxide layer will be described hereinafter.

[67]

[68] Chroma (colorimeter value)

[69] 1) High chroma-high gloss pigment

[70] Table 1

[71]

Kind	a^*	b^*	Kind	a^*	b^*
Comparative Example 1	2.64	38.51	Example 1	4.14	42.87
Comparative Example 2	31.58	-8.81	Example 2	37.10	-13.11
Comparative Example 3	29.90	-39.95	Example 3	33.16	-44.68
Comparative Example 4	-9.56	-40.16	Example 4	-12.87	-44.37
Comparative Example 5	-19.43	13.14	Example 5	-23.30	15.46
Comparative Example 6	7.83	48.01	Example 6	9.33	59.24

[72] Table 2

[73]

Kind	25°		45°		75°	
	a*	b*	a*	b*	a*	b*
Comparative Example 7	-0.25	35.36	-1.83	12.97	-2.37	1.25
Comparative Example 8	26.69	11.01	11.53	6.95	2.16	4.35
Comparative Example 9	7.18	-34.65	7.25	-19.69	3.13	-9.12
Comparative Example 10	-21.49	-13.36	-7.24	-11.56	0.54	-10.43
Comparative Example 11	-25.57	-3.59	-9.52	-8.11	-1.12	-9.21
Example 7	-0.78	41.62	-3.49	15.59	-4.42	2.65
Example 8	29.24	13.05	13.03	8.75	3.36	5.87
Example 9	8.55	-38.7	8.32	-22.88	4.68	-11.52
Example 10	-25.15	-16.19	-8.32	-14.78	1.35	-13.40
Example 11	-29.05	-5.89	-12.41	-9.35	-2.58	-11.64

[74] Referring to Tables 1 and 2, Comparative 1 to 11 employ an SiO_2 layer and Examples 1 to 11 employ an $MgO{\cdot}SiO_2$ layer.

[75] Comparing the examples with the comparative examples, it can be seen that the pigment including the $MgO{\cdot}SiO_2$ layer has improved colorimeter values (a*, b*).

[76] Here, since the chroma is improved with increasing absolute colorimeter values, it can be seen that the pigments of Examples have improved chroma.

[77]

[78] Gloss

[79] 1) High chroma-high gloss pigment

[80] Table 3

[81]

Before use	20°	60°	85°
Comparative Example 12	95.3	96.2	93.5
Comparative Example 13	93.9	96.5	93.9
Comparative Example 14	96.4	94.2	93.7
Comparative Example 15	98.1	94.6	95.1
Comparative Example 16	93.8	94.6	91.9
Comparative Example 17	100.2	97.5	93.8
Example 12	100.3	101.9	97.3
Example 13	98.2	99.0	97.7
Example 14	101.2	98.1	98.1
Example 15	102.4	98.0	97.3
Example 16	97.2	98.7	95.4
Example 17	105.2	103.9	97.9

[82]

[83] 2) Multi-color pigment

[84] Table 4

[85]

After use	20°	60°	85°
Comparative Example 18	100.1	94.8	97.5
Comparative Example 19	95.5	92.9	98.1
Comparative Example 20	94.7	91.9	94.5
Comparative Example 21	98.3	94.1	99.2
Comparative Example 22	93.5	92.8	98.6
Example 18	104.5	97.3	101.8
Example 19	100.9	97.0	102.5
Example 20	99.8	97.1	100.9
Example 21	102.1	97.2	104.8
Example 22	100.7	97.1	104.8

[86]

[87] Referring to Tables 3 and 4, Comparative 12 to 22 employ an SiO_2 layer and

Examples 12 to 22 employ an $MgO \cdot SiO_2$ layer.

[88] Comparing the examples with the comparative examples, it can be seen that the pigment including the $MgO \cdot SiO_2$ layer has improved gloss.

[89]

[90] Variation of chroma and gloss depending on content ratio of $MgO \cdot SiO_2$

[91] 1) High chroma high gloss pigment

[92] Table 5

[93]

Chroma	Content ratio (wt%)	a*	b*
Comparative Example 23	3	0.90	-1.25
Comparative Example 24	4	-0.49	1.34
Example 23	5	4.14	42.87
Example 24	10	9.33	59.24
Example 25	20	23.30	-15.46
Example 26	30	33.16	-44.68
Example 27	35	37.10	-13.11
Example 25	36	-1.28	0.91

[94] Table 6

[95]

Gloss	Content ratio (wt%)	20°	60°	85°
Comparative Example 26	3	83.9	86.5	81.9
Comparative Example 27	4	85.3	90.2	85.5
Example 28	5	98.2	99.0	97.7
Example 29	10	100.3	101.9	97.3
Example 30	20	101.2	98.1	98.1
Example 31	30	102.4	98.0	97.3
Example 32	35	105.2	103.9	97.9
Comparative Example 28	36	80.9	81.5	73.9

[96]

[97] 2) Multi-color pigment

[98] Table 7

[99]

Chroma	Content ratio (wt%)	25°		45°		75°	
		a*	b*	a*	b*	a*	b*
Comparative Example 23	3	-0.25	2.37	-0.13	0.57	-0.31	0.27
Comparative Example 24	4	-0.49	1.34	-0.49	1.34	-0.49	1.34
Example 23	5	-0.78	41.62	-3.49	15.59	-4.42	2.65
Example 24	10	-25.15	-16.19	-8.32	-14.78	1.35	-13.40
Example 25	20	-29.05	-5.89	-12.41	-9.35	-2.58	-11.64
Example 26	30	8.55	-38.7	8.32	-22.88	4.68	-11.52
Example 27	35	29.24	13.05	13.03	8.75	3.36	5.87
Comparative Example 25	36	2.57	1.38	0.27	2.39	1.84	0.25

[100] Table 8

[101]

Gloss	Content ratio (wt%)	20°	60°	85°
Comparative Example 26	3	70.8	80.7	77.4
Comparative Example 27	4	85.3	90.2	85.5
Example 28	5	99.8	97.1	100.9
Example 29	10	100.9	97.0	102.5
Example 30	20	102.1	97.2	104.8
Example 31	30	100.7	97.1	104.8
Example 32	35	104.5	97.3	101.8
Comparative Example 28	36	85.1	83.9	89.5

[102] Referring to Tables 5 to 8, it can be seen that, in Comparative Examples 23, 24, 26 and 27 having less than 5 wt% of the $MgO \cdot SiO_2$ layer, the $MgO \cdot SiO_2$ layer has an excessively low thickness, thereby providing an unsatisfactory coating ratio of the layers.

[103] That is, it can be estimated that the low thickness of the $MgO \cdot SiO_2$ layer provides insufficient coverage with respect to an underlying layer, so that the pigments of the comparative examples have a rough surface causing diffuse reflection, thereby providing relatively low chroma and gloss. In addition, by the same principle as described above, the comparative examples do not provide multi-color effects.

[104] For the pigments of the comparative examples wherein the $MgO \cdot SiO_2$ layer is present

in an amount exceeding 35 wt%, it can be seen that the $MgO \cdot SiO_2$ layer has an excessively high thickness and requirements for the coating ratio of the layers cannot be fulfilled, causing insufficient light refraction at the respective layers. As a result, the pigments of the comparative examples provide undesired colors and relatively low chroma.

[105] On the other hand, for Examples 23 to 32 wherein the content of the $MgO \cdot SiO_2$ layer is in the range according to the present invention, all of the pigments have satisfactory chroma and gloss, as shown in Table 1 to 4.

[106] As described above, the method of preparing a nacreous pigment according to the embodiment includes forming a low refractive index layer using $MgO \cdot SiO_2$, thereby providing high brightness and high gloss to the nacreous pigment with a low thickness.

[107] In addition, since there is no need there is no need to increase the thickness of the low refractive index layer in the pigment, the method ensures easy preparation of the pigment exhibiting high chroma and multi-color effects.

[108] Although some embodiments have been described herein, it should be understood by those skilled in the art that these embodiments are given by way of illustration only, and that various modifications, changes, and alterations can be made without departing from the spirit and scope of the invention. Therefore, the scope of the invention should be limited only by the accompanying claims and equivalents thereof.

Claims

[Claim 1] A method of preparing a nacreous pigment, comprising:
preparing a suspension by mixing a flake substrate containing at least one of synthetic mica, natural mica, glass, iron oxide flake, alumina flake and silica flake with de-ionized (DI) water to produce a flake mixture, followed by stirring and dispersing the mixture;
forming a first metal oxide layer on a surface of the flake substrate by titrating a first soluble inorganic metal salt solution to the suspension, followed by hydrolyzing the first inorganic metal salt solution;
forming an oxide layer on a surface of the first metal oxide layer by titrating a soluble inorganic salt solution containing $MgO \cdot SiO_2$ to the suspension obtained by titration of the first inorganic salt solution, followed by hydrolyzing the inorganic salt solution; and
forming a second metal oxide layer on the surface of the oxide layer by titrating a second soluble inorganic metal salt solution to the suspension obtained by titration of the inorganic salt solution, followed by hydrolyzing the second inorganic metal salt solution.

[Claim 2] The method of claim 1, wherein the suspension prepared by mixing the flake substrate with de-ionized water has a solid content of 5 to 20 wt%.

[Claim 3] The method of claim 1, wherein the suspension is maintained at a temperature of 60 to 90 during formation of the first metal oxide layer, the oxide layer and the second metal oxide layer.

[Claim 4] The method of claim 1, wherein each of the first and second inorganic metal salt solutions comprises at least one selected from $SnCl_4$, $TiCl_4$, $TiOCl_2$, $TiOSO_4$, $FeCl_3$, $FeSO_4$, $SiCl_4$, $ZrOCl_2$, $Na_2O \cdot SiO_2 \cdot 5H_2O$, $MnCl_2$, $MgCl_2$, $AlCl_3$, $CoCl_2$, and mixtures thereof.

[Claim 5] The method of claim 1, wherein the soluble inorganic salt solution comprises at least one selected from water glass, $MgCl_2$, silicate salt, $AlCl_3$, KCl_3, boron, and mixtures thereof.

[Claim 6] The method of claim 5, wherein the oxide layer comprises at least one selected from SiO_2, $MgO \cdot Al_2O_3$, $K_2O \cdot SiO_2$, Mg_2SiO_4, and mixtures thereof.

[Claim 7] The method of claim 1, wherein the oxide layer is present in an amount of 5 to 35 wt% with respect to a total amount of the pigment.

[Claim 8] The method of claim 1, wherein, during formation of the first metal oxide layer or formation of the second metal oxide layer, the

suspension is adjusted to have a pH in the range of 1 to 9 and is refluxed for 10 to 30 minutes after titration of the corresponding solution.

[Claim 9] The method of claim 1, wherein, during formation of the oxide layer, the suspension is adjusted to have a pH in the range of 3 to 14 and is refluxed for 30 to 60 minutes after titration of the corresponding solution.

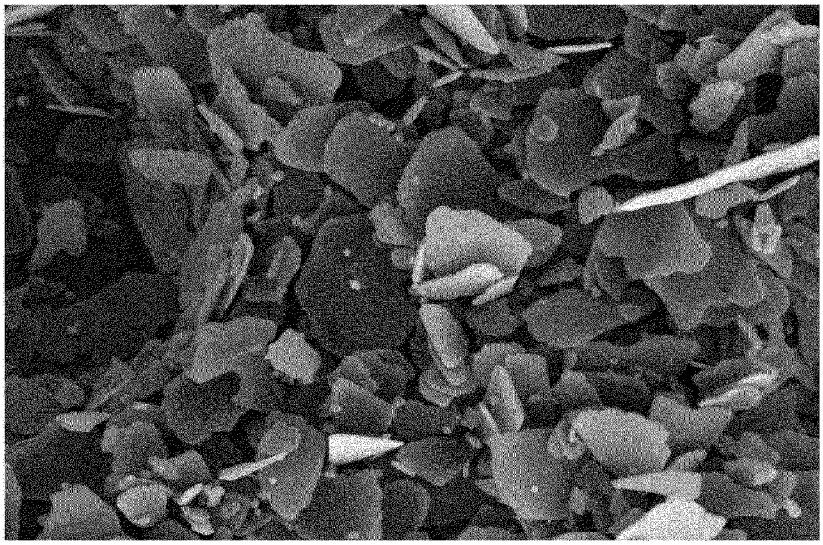
[Claim 10] A nacreous pigment comprising:
a flake substrate comprising at least one of synthetic mica, natural mica, glass, iron oxide flake, alumina flake and silica flake;
a first metal oxide layer coated on the substrate; and
an oxide layer coated on the first metal oxide layer and comprising $MgO \cdot SiO_2$; and
a second metal oxide layer coated on the oxide layer.

[Claim 11] The nacreous pigment of claim 10, wherein the oxide layer comprises at least one selected from SiO_2, $MgO \cdot Al_2O_3$, $K_2O \cdot SiO_2$, Mg_2SiO_4, and mixtures thereof.

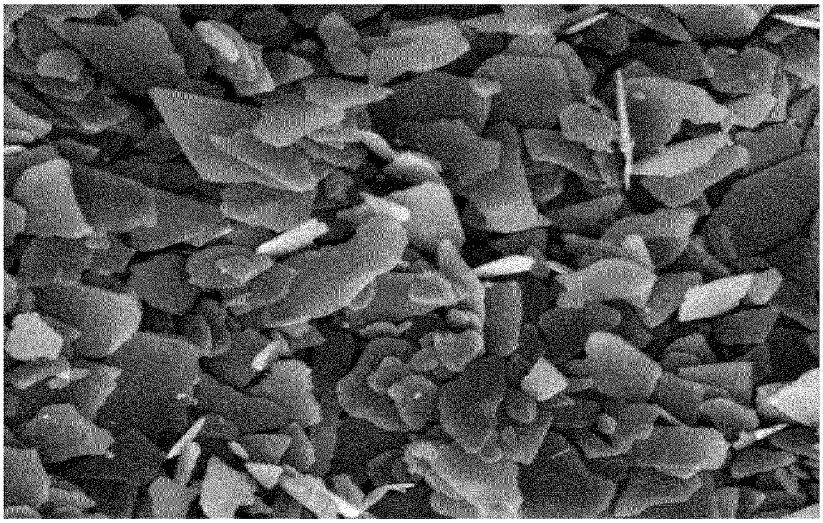
[Claim 12] The nacreous pigment of claim 10, wherein the oxide layer is present in an amount of 5 to 35 wt% with respect to a total amount of the pigment.

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[Fig. 1]



[Fig. 2]



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2011/003137

A. CLASSIFICATION OF SUBJECT MATTER

C09C 3/06(2006.01)i, C09C 3/12(2006.01)i, C09C 3/00(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

C09C 3/06; C09C 3/00; C09C 1/36; A61K 7/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & Keywords: nacreous, pigment, flake, metal oxide, MgO, SiO2, inorganic salt

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	KR 10-0337000 B1 (CHANG, KIL WAN & LIM, KWANG SU) See abstract; page 3; claims 1-6	10-12
A	----------	1-9
	See the whole document	
A	JP 2000-502401 A (MERCK PATENT GMBH.) 29 February 2000 See the whole document	1-12
A	JP 2002-535435 A (MERCK PATENT GMBH.) 22 October 2002 See the whole document	1-12
A	JP 2003-268260 A (MERCK PATENT GMBH.) 25 September 2003 See the whole document	1-12

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:
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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
21 MARCH 2012 (21.03.2012)	**22 MARCH 2012 (22.03.2012)**

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

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