

Description**BACKGROUND OF THE INVENTION**

This invention relates to a method for fabricating a cordierite body which has a low coefficient of thermal expansion (CTE). The invention relates also to a method of fabricating the body which makes use of a composition of raw materials in which at least a portion of the raw materials is provided as magnesium aluminate spinel which will be referred to as spinel. The raw materials are absent of clay and absent of talc. More particularly, the body is formed by extrusion. Still more particularly, the extruded body has a honeycomb structure. A cordierite body having a honeycomb structure is especially suited for but not limited to use as a substrate for a catalytic converter for automobiles.

Extruded cordierite honeycombs are manufactured for use as substrates to support catalytically active components for catalytic converters on automobiles. Use of cordierite is favorable in this application because of its good thermal shock resistance. The thermal shock resistance (TSR) is inversely proportional to the coefficient of thermal expansion (CTE). That is, honeycombs with a low thermal expansion have good thermal shock resistance and can survive the wide temperature fluctuations that are encountered in the application.

Up to this time cordierite has been made typically with starting raw materials of clay, talc and alumina. U.S. Patent 3,885,977 relates to extruded honeycombed monolithic fired ceramics made with these raw materials. In this patent it is stated that the orientation of the cordierite crystals in the fired body as measured by the I ratio, comes about because cordierite forms on oriented clay particles which are aligned by the extrusion process resulting in the desired low CTE. Therefore it was believed that the clay was necessary to form cordierite.

U.S. Patent 4,280,845 relates to cordierite ceramic fabricated from a mixture of magnesia material, alumina, and silica raw materials using clay and talc predominately. The magnesia has a particle size of 5-150 microns. Although there are some examples given of using ternary end member oxides, that is magnesium oxide, aluminum oxide, and silica without clay or talc, there is no teaching of using magnesium aluminate spinel as a raw material.

In U.S. Patent 4,434,117, it has been further suggested that the use of a platy talc without clay is a necessary and sufficient condition in order to achieve a cordierite body with a low coefficient of thermal expansion when this platy talc is combined with other non-clay components to obtain the cordierite composition.

EP 0 354 721 discloses porous ceramic honeycomb filters and a method of producing the same. The starting material for producing the ceramic filter includes talc in all cases.

According to one problem of the invention a method shall be provided for fabricating cordierite bodies avoiding the inclusion of clay and/or talc.

The present invention provides, therefore, a method fabricating a cordierite body, said method comprising:

- a) selecting raw materials to form a nominal composition consisting essentially of in percent by weight 11.5 to 16.5 MgO, 33.0 to 41.0 Al_2O_3 , and 46.5 to 53 SiO_2 said raw materials being selected from the group consisting of a first combination consisting essentially of silica and magnesium aluminate spinel, a second combination consisting essentially of silica, magnesium aluminate spinel, and a MgO yielding component, and a third combination consisting essentially of silica, magnesium aluminate spinel, and a Al_2O_3 yielding component, said raw materials being provided absent of clay and absent of talc;
- b) intimately blending said raw materials with an effective amount of vehicle and forming aids to impart plastic formability and green strength to said raw materials and form a plastic mixture;
- c) forming said raw materials into a green body;
- d) drying said green body; and
- e) firing said green body at a sufficient temperature for a sufficient time to form a cordierite body of at least 90% by weight cordierite, wherein the coefficient of thermal expansion of said cordierite body is less than $16 \times 10^{-7}/^\circ\text{C}$ from 25°C to about 1000°C .

SUMMARY OF THE INVENTION

In accordance with the invention, there is provided the following method for fabricating a body which is at least 90% by weight cordierite, and has a coefficient of thermal expansion of less than $16 \times 10^{-7}/^\circ\text{C}$ from 25°C to 1000°C . Raw materials are selected to form a nominal composition consisting essentially of in percent by weight 11.5 to 16.5 MgO, 33.0 to 41.0 Al_2O_3 , and 46.5 to 53 SiO_2 . The raw materials can be a

combination of silica and magnesium aluminate spinel, a combination of silica, magnesium aluminate spinel, and a MgO yielding component, or a combination of silica, magnesium aluminate spinel, and a Al_2O_3 yielding component. The raw materials are provided absent of clay and talc. The raw materials are blended with an effective amount of vehicle and forming aids to impart plastic formability and green strength thereto and form a plastic. The raw materials are formed into a green body which is dried and fired at a sufficient temperature for a sufficient time to form the cordierite body.

BRIEF DESCRIPTION OF THE FIGURE

- 10 Figure 1 is a ternary phase diagram of the SiO_2 - Al_2O_3 -MgO system showing the region of the raw material compositions of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

- 15 This invention relates to a method for fabricating cordierite bodies which makes use of a two component raw material composition of magnesium aluminate spinel and silica. The compositions can have minor additions of an aluminum oxide component or a magnesium oxide component. The raw materials are provided without clay and without talc. According to the present invention clay and talc are taken to mean clay and talc as is, or their calcined equivalents, that is, clays and talcs which have had their crystalline water removed, for example, by heating. The body has a low CTE, and is well oriented as measured by the I ratio using x-ray diffraction techniques.

The bodies fabricated by the method of the present invention can have any shape and size convenient for the application. In accordance with a preferred embodiment, the bodies have a honeycomb structure which is obtained preferably by extrusion.

- 25 Honeycomb bodies contain open cells which are formed by thin porous intersecting walls. The entirety of the open cells is enclosed by an outer wall which defines the shape of the body. The cells normally extend along the length of the body and occupy the entire length. There can be any number or density of cells. Typically however, honeycombs have transverse cell densities of 7.75 cells/cm² to 400 cells/cm² or more with wall thicknesses of 0.05 mm to 1.27 mm, although this can vary with the application.

- 30 The bodies of the present invention especially in the above described honeycomb structure are suitable for use as catalytic converters especially but not exclusively for use in automobiles.

- The raw materials of the present invention are selected to form a nominal composition consisting essentially of in percent by weight 11.5 to 16.5 MgO, 33.0 to 41.0 Al_2O_3 , 46.5 to 53 SiO_2 . This composition is shown in Figure 1 by the area FGHJK. One preferred nominal composition consists essentially of in percent by weight 12.5 to 15.5 MgO, 34.2 to 39.5 Al_2O_3 , 48.0 to 51.6 SiO_2 . This preferred composition is shown in Figure 1 by the area ABCDE.

The raw materials can be in combinations as follows:

- (1) a first combination consisting essentially of silica, and spinel,
 (2) a second combination consisting essentially of silica, spinel, and a MgO yielding component. The MgO yielding component is provided preferably in the form of magnesium oxide itself, magnesium hydroxide, magnesium carbonate, magnesium nitrate, and combinations of these, and
 (3) a third combination consisting essentially of silica, spinel, and a Al_2O_3 yielding component. The Al_2O_3 yielding component is provided preferably in the form of aluminum oxide itself, aluminum hydroxide, aluminum nitrate, aluminum carbonate, and combinations of these.

- 45 One especially preferred composition consists essentially of in percent by weight 48.6% spinel and the balance silica. The compositions of the present invention result in formation of cordierite in the subsequent firing step.

- The magnesium aluminate spinel $\text{MgO} \cdot \text{Al}_2\text{O}_3$, can be obtained from any source. It is desirable that the mean particle diameter of the spinel be less than 15 micrometers. Particle size measurements referred to in the present invention are measured by Microtrac analysis.

The silica can be any of the types commercially available. One preferred silica is an alpha quartz with a median particle size of 6.0 micrometers in diameter.

- Although the composition is relatively pure, some allowance is made for impurities. Impurities within the cordierite body are of concern since these can affect properties such as increasing CTE. Typically cordierite bodies are affected by impurities such as CaO, K_2O , Na_2O , Fe_2O_3 , etc. and can contain total body impurities up to 3.0% by weight. These impurities must be closely controlled. In the cordierite bodies of the present teaching, the components spinel and silica are generally synthetic or high purity with a total purity content of $\leq 0.5\%$ by weight for the final body.

The above composition of raw materials is intimately blended with a vehicle and forming aids which impart plastic formability and green strength to the raw materials when they are shaped into a body. When the forming is done by extrusion, the extrusion aids most typically used are methyl cellulose which serves as a binder, and a lubricant such as sodium stearate, although the invention is not limited to these.

5 The relative amounts of forming aids can vary depending on factors such as nature and amounts of raw materials used, etc. However, the typical amounts are 2% to 10% and preferably 3% to 6% by weight of methyl cellulose, and 0.5% to 1% by weight sodium stearate and preferably .6% by weight. As an example of how the percent levels of forming aids are determined: for a 1000 g batch based on the oxide content, (MgO, Al₂O₃, and SiO₂) for a 5% by weight level of methyl cellulose, 50 g of methyl cellulose would be
10 added to the batch, and for a 0.5% by weight level of sodium stearate, 5 g of sodium stearate would be added.

In accordance with a preferred embodiment, for an extrusion process, the raw material composition and extrusion aids are mixed in dry form and then mixed with water as the vehicle. The amount of water can vary from one batch of materials to another and therefore is determined by pre-testing the particular batch
15 for extrudability, that is for ability to attain the proper extrusion pressures.

The raw materials in the resulting plastic mixture are then formed into a green body. Bodies which have not been sintered are referred to as green bodies. The forming can be done by any method. The forming is done preferably by extrusion. Extrusion techniques are well known in the art. Some examples of preferred techniques will be given in the examples that follow for fabrication of the preferred types of bodies. The
20 body is extruded preferably into a honeycomb body.

Once the green body is formed it is dried and then fired at a sufficient temperature for a sufficient time to form a cordierite body. The firing is done preferably according to the following schedule. The body is heated from room temperature (approximately 25 °C) to 1380 °C to 1450 °C and held for a sufficient time to form cordierite.

25 The resulting fired body is at least about 90% by weight cordierite.

The body is characterized by a low CTE. For example, the CTE is less than $16 \times 10^{-7}/^{\circ}\text{C}$ from 25 °C to 1000 °C. Typically the CTE is less than $11 \times 10^{-7}/^{\circ}\text{C}$ from 25 °C to 1000 °C. And most typically the CTE is less than $8 \times 10^{-7}/^{\circ}\text{C}$ from 25 °C to 1000 °C.

The body when formed as a honeycomb structure for example, by extrusion, is further characterized by
30 the I ratio. The I ratio is represented by the formula

$$\text{I ratio} = \frac{I_{(110)}}{I_{(110)} + I_{(002)}}$$

35 where $I_{(110)}$ and $I_{(002)}$ are the peak heights of the reflections from the (110) and (002) planes respectively. The axial and transverse I ratio refer to different orientations of a honeycomb sample in the x-ray beam. The x-ray beam impinges a planar surface at an angle. Measurements of the transverse I ratio are made when the planar surface of the sample is the flat surface made up of as formed wall surfaces of the honeycomb. Measurements of the axial I ratio are made off a plane which is perpendicular to that for a transverse I ratio where the planar surface on which the x-rays impinge consists of the cross-sectional ends of the
45 honeycomb webs. For a completely randomly oriented cordierite, the I ratio will be 0.65. If the I ratio measured in the transverse direction with respect to the extrusion direction of the body exceeds 0.69 or the axial I ratio with respect to the extrusion direction is less than 0.61, then the cordierite crystallites are becoming substantially oriented with respect to the plane of the webs. A high transverse I ratio, or conversely, a low axial I ratio will yield a low thermal expansion as measured in the extrusion or axial
50 direction. It should be noted that in some cases the thermal expansion can be lower than expected from I ratio alone and this can be due to the influence of microcracking as is well known in the state of the art for anisotropic polycrystalline bodies. The bodies of the present invention typically have a transverse I ratio of greater than 0.69, and an axial I ratio of less than 0.61.

The porosity of the bodies is less than 35%. The shrinkage and porosity vary as the composition of the
55 raw materials varies within the range of the invention.

To more fully illustrate this invention, the following non-limiting example is presented.

Example

Several 1000g batches of dry powders are made of the the components spinel, silica, magnesium oxide, and aluminum oxide as raw materials for subsequent formation of a cordierite honeycomb. The raw material batches are each mixed with methyl cellulose and sodium stearate as a lubricant for the subsequent extrusion operation. The raw materials, methyl cellulose and sodium stearate are mixed in a Littleford mixer for 3 minutes in order to obtain a homogeneous dry blend. The batch is then transferred to a plasticizing mixer such as a muller, sigma blade mixer, etc. and water is added to the dry components in an amount sufficient to form a plasticized batch. The resulting mix is blended for 10-15 minutes to make a plastic mixture. One inch diameter green honeycomb pieces with a geometry of 62 cells/cm² and 0.15 mm wall thickness are extruded using a 25 ton ram extruder. After drying, the green pieces are fired by heating to a temperature of 1430 °C and maintaining that temperature for 10 hours. The properties of the fired bodies are given in Table 1 below for the various compositions.

Table 1

Description	Batch No.				
	1	2	3	4	5
Components (wt. % in batch)					
Spinel (Cernel 75)	48.6		50.5	48.6	32.2
Spinel (Sumitomo)		48.6			
Silica (Imsil A-25)	51.4	51.4	49.0	49.0	67.8
MgO			0.5		
Al ₂ O ₃				2.4	
Methyl cellulose Methocel ^R	6.0	6.0	6.0	6.0	6.0
Sodium stearate	0.6	0.6	0.6	0.6	0.6
Water content (wt. % of dry powders)	41.5	20.6	45.0	44.5	34.5
Firing schedule: top temp °C/hrs. held	1430/10	1430/10	1430/10	1430/10	1380/5
Properties of cordierite body					
CTE ₂₅₋₃₀₀ (x 10 ⁻⁷)/°C	5.0	1.8	9.3	10.5	29.0
CTE ₂₅₋₁₀₀₀ (x 10 ⁻⁷)/°C	6.8	4.0	10.9	11.8	25.8
I ratio (transverse)	0.79	0.85	0.74	0.77	0.83
Firing shrinkage %	7.3	+0.36	28.8	27.1	3.4
Porosity %	31.7	27.9	16.0	22.0	33.2
Pore size, μm	5.0	5.0	6.5	5.4	1.2
MOR, (psi) kPa	(2510) 17319	(2900) 20010	(2990) 20631	(3850) 26565	

The positions of compositions 1-4 are shown in the phase diagram in Figure 1.

It can be seen that with the compositions of the present invention, Batches 1, 2, 3 and 4, the CTE's are low, the transverse I ratios are high and the porosity is relatively low. Batch 5, the raw material composition of which is outside the present invention exhibits a high CTE in the product body because it has a high amount of cristobalite in addition to cordierite.

It is interesting to note that the above batches made without clay and without talc are highly oriented as measured by the I ratio. These examples demonstrate also that low CTE cordierite bodies can be obtained with a two component system consisting of magnesium aluminate spinel and silica.

Claims

- A method of fabricating a cordierite body, said method comprising:
 - selecting raw materials to form a nominal composition consisting essentially of in percent by weight 11.5 to 16.5 MgO, 33.0 to 41.0 Al₂O₃, and 46.5 to 53 SiO₂ said raw materials being selected from the group consisting of a first combination consisting essentially of silica and magnesium aluminate spinel, a second combination consisting essentially of silica, magnesium aluminate spinel, and a MgO yielding component, and a third combination consisting essentially of silica, magnesium aluminate spinel, and a Al₂O₃ yielding component, said raw materials being provided absent of clay and absent of talc;

Example

Several 1000g batches of dry powders are made of the the components spinel, silica, magnesium oxide, and aluminum oxide as raw materials for subsequent formation of a cordierite honeycomb. The raw material batches are each mixed with methyl cellulose and sodium stearate as a lubricant for the subsequent extrusion operation. The raw materials, methyl cellulose and sodium stearate are mixed in a Littleford mixer for 3 minutes in order to obtain a homogeneous dry blend. The batch is then transferred to a plasticizing mixer such as a muller, sigma blade mixer, etc. and water is added to the dry components in an amount sufficient to form a plasticized batch. The resulting mix is blended for 10-15 minutes to make a plastic mixture. One inch diameter green honeycomb pieces with a geometry of 62 cells/cm² and 0.15 mm wall thickness are extruded using a 25 ton ram extruder. After drying, the green pieces are fired by heating to a temperature of 1430°C and maintaining that temperature for 10 hours. The properties of the fired bodies are given in Table 1 below for the various compositions.

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Description	Batch No.				
Components (wt. % in batch)	1	2	3	4	5
Spinel (Cernel 75)	48.6		50.5	48.6	32.2
Spinel (Sumitomo)		48.6			
Silica (Imasil A-25)	51.4	51.4	49.0	49.0	67.8
MgO			0.5		
Al ₂ O ₃				2.4	
Methyl cellulose Methocel ^R	6.0	6.0	6.0	6.0	6.0
Sodium stearate	0.6	0.6	0.6	0.6	0.6
Water content (wt. % of dry powders)	41.5	20.6	45.0	44.5	34.5
Firing schedule: top temp °C/hrs. held	1430/10	1430/10	1430/10	1430/10	1380/5
Properties of cordierite body					
CTE ₂₅₋₈₀₀ (x 10 ⁻⁷)/°C	5.0	1.8	9.3	10.5	29.0
CTE ₂₅₋₁₀₀₀ (x 10 ⁻⁷)/°C	6.8	4.0	10.9	11.8	25.6
I ratio (transverse)	0.79	0.85	0.74	0.77	0.83
Firing shrinkage %	7.3	+0.36	28.8	27.1	3.4
Porosity %	31.7	27.9	16.0	22.0	33.2
Pore size, μm	5.0	5.0	6.5	5.4	1.2
MOR, (psi) kPa	(2510) 17319	(2900) 20010	(2990) 20631	(3850) 26565	

The positions of compositions 1-4 are shown in the phase diagram in Figure 1.

It can be seen that with the compositions of the present invention, Batches 1, 2, 3 and 4, the CTE's are low, the transverse I ratios are high and the porosity is relatively low. Batch 5, the raw material composition of which is outside the present invention exhibits a high CTE in the product body because it has a high amount of cristobalite in addition to cordierite.

It is interesting to note that the above batches made without clay and without talc are highly oriented as measured by the I ratio. These examples demonstrate also that low CTE cordierite bodies can be obtained with a two component system consisting of magnesium aluminate spinel and silica.

Claims

1. A method of fabricating a cordierite body, said method comprising:

- selecting raw materials to form a nominal composition consisting essentially of in percent by weight 11.5 to 16.5 MgO, 33.0 to 41.0 Al₂O₃, and 46.5 to 53 SiO₂ said raw materials being selected from the group consisting of a first combination consisting essentially of silica and magnesium aluminate spinel, a second combination consisting essentially of silica, magnesium aluminate spinel, and a MgO yielding component, and a third combination consisting essentially of silica, magnesium aluminate spinel, and a Al₂O₃ yielding component, said raw materials being provided absent of clay and absent of talc;



- b) intimately blending said raw materials with an effective amount of vehicle and forming aids to impart plastic formability and green strength to said raw materials and form a plastic mixture;
 c) forming said raw materials into a green body;
 d) drying said green body; and
 e) firing said green body at a sufficient temperature for a sufficient time to form a cordierite body of at least 90% by weight cordierite, wherein the coefficient of thermal expansion of said cordierite body is less than $16 \times 10^{-7}/^{\circ}\text{C}$ from 25°C to about 1000°C .
2. A method of claim 1 wherein said nominal composition consists essentially of in percent by weight 12.5 to 15.5 MgO, 34.2 to 39.5 Al_2O_3 , and 48.0 to 51.6 SiO_2 .
3. A method of claim 1 wherein said magnesium oxide yielding component is selected from the group consisting of magnesium oxide, magnesium hydroxide, magnesium carbonate, magnesium nitrate, and combinations thereof.
4. A method of claim 1 wherein said aluminum oxide yielding component is selected from the group consisting of aluminum oxide, aluminum hydroxide, aluminum nitrate, aluminum carbonate, and combinations thereof.
5. A method of claim 1 wherein said forming is done by extruding said raw materials into said green body.
6. A method of claim 1 wherein green body is formed to a honeycomb structure.
7. A method of claim 6 wherein the transverse I ratio of said cordierite body is greater than 0.69, and wherein the axial I ratio is less than 0.61.
8. A method of claim 1 wherein said coefficient of thermal expansion is less than $11 \times 10^{-7}/^{\circ}\text{C}$ from 25°C to 1000°C .
9. A method of claim 8 wherein said coefficient of thermal expansion is less than $8 \times 10^{-7}/^{\circ}\text{C}$ from 25°C to 1000°C .

Patentansprüche

1. Verfahren zur Herstellung eines Cordierit-Körpers, umfassend:
- a) Auswählen von Rohmaterialien zur Bildung einer nominellen Zusammensetzung, bestehend im wesentlichen, ausgedrückt in Gew.-%, aus 11,5 bis 16,5 MgO, 33,0 bis 41,0 Al_2O_3 und 46,5 bis 53 SiO_2 , wobei die Rohmaterialien aus der Gruppe, bestehend aus einer ersten Kombination, bestehend im wesentlichen aus Siliciumdioxid und Magnesiumaluminat-Spinell, einer zweiten Kombination, bestehend im wesentlichen aus Siliciumdioxid, Magnesiumaluminat-Spinell und einem MgO bildenden Bestandteil, und einer dritten Kombination, bestehend im wesentlichen aus Siliciumdioxid, Magnesiumaluminat-Spinell und einem Al_2O_3 ergebenden Bestandteil, ausgewählt werden, wobei die Rohmaterialien ohne Ton und Talkum bereitgestellt werden;
- b) inniges Vermischen der Rohmaterialien mit einer wirksamen Menge eines Trägers und von Formgebungshilfsmitteln, um den Rohmaterialien eine plastische Formbarkeit und eine grüne Festigkeit zu verleihen und eine plastische Mischung zu formen;
- c) Formen der Rohmaterialien zu einem grünen Körper;
- d) Trocknen des grünen Körpers; und
- e) Brennen des grünen Körpers bei einer ausreichenden Temperatur für einen ausreichenden Zeitraum zur Formung eines Cordierit-Körpers aus wenigstens 90 Gew.-% Cordierit, wobei der Wärmeausdehnungskoeffizient des Cordierit-Körpers weniger als $16 \times 10^{-7}/^{\circ}\text{C}$ von 25°C bis etwa 1000°C beträgt.
2. Verfahren nach Anspruch 1, wobei die nominelle Zusammensetzung im wesentlichen, ausgedrückt in Gew.-%, aus 12,5 bis 15,5 MgO, 34,2 bis 39,5 Al_2O_3 und 48,0 bis 51,6 SiO_2 besteht.
3. Verfahren nach Anspruch 1, worin der Magnesiumoxid bildende Bestandteil aus der Gruppe von Magnesiumoxid, Magnesiumhydroxid, Magnesiumcarbonat, Magnesiumnitrat und Kombinationen hier-



von ausgewählt wird.

4. Verfahren nach Anspruch 1, wobei der Aluminiumoxid bildende Bestandteil aus der Gruppe von Aluminiumoxid, Aluminiumhydroxid, Aluminiumnitrat, Aluminiumcarbonat und Kombinationen hiervon ausgewählt wird.
5. Verfahren nach Anspruch 1, wobei die Formgebung durch Extrudieren der Rohmaterialien zum grünen Körper durchgeführt wird.
6. Verfahren nach Anspruch 1, worin der grüne Körper zu einer wabenförmigen Struktur geformt wird.
7. Verfahren nach Anspruch 6, wobei das I-Querverhältnis des Cordierit-Körpers über 0,69 und das I-Axialverhältnis unter 0,61 liegt.
8. Verfahren nach Anspruch 1, wobei der Wärmeausdehnungskoeffizient weniger als $11 \times 10^{-7}/^{\circ}\text{C}$ von 25°C bis 1000°C beträgt.
9. Verfahren nach Anspruch 8, worin der Wärmeausdehnungskoeffizient weniger als $8 \times 10^{-7}/^{\circ}\text{C}$ von 25°C bis 1000°C beträgt.

Revendications

1. Procédé de fabrication d'un corps en cordiérite, ledit procédé comprenant :
 - a) une sélection de matières premières pour former une composition nominale consistant essentiellement en un pourcentage en poids de 11,5 à 16,5 en MgO , de 33,0 à 43,0 en Al_2O_3 , et de 46,5 à 53 en SiO_2 , lesdites matières premières étant choisies dans le groupe formé par une première combinaison consistant essentiellement en silice et spinelle d'aluminate de magnésium, une seconde combinaison consistant essentiellement en silice, spinelle d'aluminate de magnésium et un composant donnant du MgO , et une troisième combinaison consistant essentiellement en silice, spinelle d'aluminate de magnésium et un composant donnant du Al_2O_3 , lesdites matières premières étant dépourvues d'argile et de talc ;
 - b) un mélange intime desdites matières premières avec une quantité efficace de moyens d'assistance à la propagation et à la conformation afin de transmettre une formabilité plastique et la résistance du vert auxdites matières premières et de former un mélange plastique ;
 - c) la conformation desdites matières premières en un corps vert ;
 - d) le séchage dudit corps vert ; et
 - e) le chauffage dudit corps vert à une température suffisante pendant un temps suffisant pour former un corps en cordiérite d'au moins 90 % en poids de cordiérite, dans lequel le coefficient de dilatation thermique dudit corps en cordiérite est inférieur à $16 \times 10^{-7}/^{\circ}\text{C}$ de 25°C à environ 1000°C .
2. Procédé selon la revendication 1 dans lequel ladite composition nominale consiste essentiellement en un pourcentage en poids de 12,5 à 15,5 en MgO , 34,2 à 39,5 en Al_2O_3 , et 48,0 à 51,6 en SiO_2 .
3. Procédé selon la revendication 1 dans lequel ledit composant donnant de l'oxyde de magnésium est choisi dans le groupe formé par l'oxyde de magnésium, l'hydroxyde de magnésium, le carbonate de magnésium, le nitrate de magnésium, et des combinaisons de ceux-ci.
4. Procédé selon la revendication 1, dans lequel ledit composant donnant de l'oxyde d'aluminium est choisi dans le groupe formé par l'oxyde d'aluminium, l'hydroxyde d'aluminium, le nitrate d'aluminium, le carbonate d'aluminium, et des combinaisons de ceux-ci.
5. Procédé selon la revendication 1, dans lequel ladite conformation est réalisée par extrusion desdites matières premières en ledit corps vert.
6. Procédé selon la revendication 1, dans lequel le corps vert conformé en une structure en nid d'abeilles.



7. Procédé selon la revendication 6, dans lequel le rapport transversal l dudit corps en cordiérite est supérieur à 0,69 et dans lequel le rapport axial l est inférieur à 0,61.
8. Procédé selon la revendication 1, dans lequel ledit coefficient de dilatation thermique est inférieur à $11 \times 10^{-7}/^{\circ}\text{C}$ de 25°C à $1\,000^{\circ}\text{C}$.
9. Procédé selon la revendication 8, dans lequel ledit coefficient de dilatation thermique est inférieur à $8 \times 10^{-7}/^{\circ}\text{C}$ de 25°C à $1\,000^{\circ}\text{C}$.

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