OPIC
Office de la propriété intellectuelle du Canada

CIPO
Canadian Intellectual Property Office

(12) (19) (CA) **Demande-Application**

(21) (A1) **2,266,769**
(22) 1999/03/24
(43) 1999/09/30

(72) GORDES, Petru, DK
(72) CHRISTIANSEN, Niels, DK
(71) HALDOR TOPSOE A/S, DK

(51) Int.Cl.[6] C04B 35/50
(30) 1998/03/31 (60/080/210) US

(54) **CERAMIQUE AU SPATH FLUOR**
(54) **FLUORITE CERAMIC MATERIAL**

$$A_xB_yO_{2-\delta}$$

(57) Ceramic material, having the general formula: (see above formula) wherein x < 1, y < 1 and -1 < .delta. < 1; A is one or more metals selected from the group of Ti, Zr, Hf, Ce and Th or mixtures thereof; B is at least two metals selected from group 2a, 3b and the lanthanide group of metals.

ABSTRACT

Ceramic material, having the general formula:

$$A_xB_yO_{2-\delta}$$

wherein

$x \leq 1$, $y \leq 1$ and $-1 < \delta < 1$;

A is one or more metals selected from the group of Ti, Zr, Hf, Ce and Th or mixtures thereof;

B is at least two metals selected from group 2a, 3b and the lanthanide group of metals.

(a) TITLE OF THE INVENTION

FLUORITE CERAMIC MATERIAL

(b) TECHNICAL FIELD TO WHICH THE INVENTION RELATES

The present invention relates to a ceramic material. In particular, it related to fluorite-type ceramics for use in the preparation of ion- and/or electronic-conducting ceramic products. In particular, it relates to membranes which are useful for the separation of oxygen and oxygen-containing gas mixtures and for electrolytes in fuel cells and electrochemical reactors.

(c) BACKGROUND ART

Fluorite ceramic materials for use in oxygen transport membranes have the general formula:

$$A_xB_yO_{2-\delta}$$

where

$x \leq 1$ and $y \leq 1$ and $-1 < \delta < 1$, and
A is one or more metals selected from the group of Ti, Zr, Hf, Ce and Th,
B is Sm plus at least one metal selected from the group 2a and 3b and other lanthanides.

Classical ceramic materials for oxygen conductors are based on zirconia doped with metal e.g., Y, Mg and Ca.

Other ceramic oxygen conductors are based on ceria doped with metals e.g., Y, Sm and Gd. These materials may exhibit mixed ionic and electronic conductivity depending

on oxygen partial pressure. The ceria based materials have higher conductivity than the zirconia based materials at temperatures below 1000°C which makes the ceria based ceramics potential for commercial oxygen separation, fuel cell application and catalysts. However, prices for pure ceria and pure dopants are prohibitive for a more wide-spread commercialization. Furthermore, the pure mixed oxides typically used may be very refractory and very difficult to sinter into dense ceramic components.

(d) DESCRIPTION OF THE INVENTION

The invention provides a novel ceramic material having fluorite structure with high oxygen ionic or mixed oxygen ionic and electronic conductivity at high or intermediate temperatures.

In accordance with the present invention, the novel material has the general formula:

$$A_xB_yO_{2-\delta}$$

where

$x \leq 1$, $y \leq 1$ and $-1 < \delta < 1$ and A is one or more metals selected from the group of Ti, Zr, Hf, Ce and Th, B is at least two metals selected from the group 2a, 3b and other lanthanides.

(e) AT LEAST ONE MODE FOR CARRYING OUT THE INVENTION

The Ce containing fluorites may be produced by replacing pure Ce raw materials with cheaper Ce concentrates based on partly refined bastnasite minerals. As the prices for pure dopants designated B in the general formula may be prohibitive for a more widespread commercialization these components are replaced according to the present investigation with "impure" partly refined mixed oxides containing Sm, Gd and Y.

CLAIMS

1. Ceramic material, having the general formula:

$$A_xB_yO_{2-\delta}$$

wherein $x \leq 1$, $y \leq 1$ and $-1 < \delta < 1$;
A is one or more metals selected from the group of Ti, Zr, Hf, Ce and Th or mixtures thereof;
B is at least two metals selected from group 2a, 3b and the lanthanide group of metals.

2. The ceramic material of claim 1, wherein A comprises Ce concentates of bastnasite minerals.

3. The ceramic material of claim 1 or claim 2, wherein B comprises mixed oxides of Sm, Gd and Y.