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(54) **Method for preparing cermets.**

(57) A method of preparing cermets from siliceous or silica-containing ceramic products by submitting these compacted products to the action of a molten alloy of aluminium and silicon, according to the reaction $3SiO2 + 4Al \rightarrow 3Si + 2Al2O3$.

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METHOD FOR PREPARING CERMETS

This invention relates to a method for preparing ceramic metals on the basis of Al_2O_3 and Si, from ceramic siliceous or silica containing products.

The methods for preparing cermets, known hitherto, have been described in the book of T. Gibas "Ceramals and cermets", WNT Warszawa, 1961, pp. 206-220. Said methods consist in pressing of compacts from powdered metals and ceramic powders and in sintering them at high temperatures and in suitable atmospheres, or in simultaneous pressing and sintering thereof. The described methods comprise the preparation of cermets on the basis of Al_2O_3 - Fe, Al_2O_3 - Cr, Al_2O_3 - Al, Al_2O_3 - Mo, Al_2O_3 - Co, Al_2O_3 - Ni, Al_2O_3 - Ag.

A disadvantage of known methods for preparing cermets are the high costs of their production, mainly due to the preparation of metallic powders with defined shape and size of grains, and to the process of pressing at high pressures.

The essence of the invention consists in that the siliceous or silica containing ceramic products are submitted to the action of a reducing agent in form

of aluminium and silicon alloy in molten state, preferably of a temperature of 750°C. The reducing agent according to the invention contains preferably 3-11% metallic silicon.

The advantages of the invention are among others the elimination of the production process of employing powdered metals, of the high-pressure pressing of compacts, and of the complicated operation of sintering of compacts, very good physical and chemical properties of cermets obtained in the method according to the invention, the possibility of preparing cermets having various physical and chemical properties, depending on the chemical composition of the ceramic product.

The method according to the invention enables the ceramic metals of various physical and chemical properties to be obtained depending on the quantity of silica (SiO_2) and other components contained in a ceramic product submitted to the action of the reducing agent.

The ceramic metals can be prepared from every ceramic silica containing product such as chamotte, porcelain, bonded silica carbide, clay, bonded alumina, silica glass etc. The reducing time depends on the quantity of silica contained in a ceramic product, the more silica the quicker reaction and the time depends on the size of compacts as well as on their density and the bigger compact the higher density and the longer reaction time.

The reduction process only consists in immersion of ceramic compact in molten aluminium-silicon (AlSi)

alloy for 2-10 days. The volume of bath is generally bigger than the volume of ceramic compacts and does not require any correction during reduction process. The quicker reduction process the bigger content of silica in Al-Si alloy.

During reduction ceramic compact does not change its volume but its density increases according to the given reaction.

Example

The cylindrical ceramic compact having the diameter of 50 mm and height of 50 mm and having the SiO_2 content of 98%, the density of 1.9 g/cm^3, and the open porosity of 15% is immersed in molten aluminium containing 3% of silicon, at the temperature of 780°C, after preliminary heating it up to the temperature of 750°C.

The compact is held in molten aluminium at the temperature of 730°C for a period of 125 hours in order to enable the total reduction of silica according to the reaction

$$3\ SiO_2 + 4\ Al = 3\ Si + 2\ Al_2O_3$$

After this period the compact is removed from the metal bath and slowly cooled down to the ambient temperature.

The outside surfaces are cleaned from possible oxide accretions, whereby the cleaning operation can be carried out on a cold, or a hot compact immediately after being removed from the bath.

The cermet compact obtained in this way, of steely-silvery colour, has the following chemical composition and more important physical and chemical properties:

Al_2O_3	68% by weight
Si	25% by weight
Al	7% by weight

Density	3.25	g/cm³
Thermal conductivity	35	Kcal/m°Ch
Specific resistance (at 20°C)	0.35	cm
Coefficient of linear expansion within the range of 20-1000°C	-5.8×10^{-6}	1/deg
Modulus of elasticity	19000	kgf/mm²
Refractoriness under load	1400	°C
Open porosity	0	%
Bending strength	20	kgf/mm²

The cermet characterizes by very high resistance to oxidation up to the temperature of 1400°C, and by high resistance to the action of molten zinc and aluminium, and resistance to wearing.

The application range is very broad, it comprises among others the casings for thermoelements, crucibles for melting zinc and aluminium, heat exchangers, responsible parts of machines and installations, heating resistors.

Claim

A method for preparing cermets characterized in that siliceous or silica containing products are submitted to the action of a reducing agent in form of aluminium and silicon alloy at molten state.

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EUROPEAN SEARCH REPORT

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Application number

EP 82 11 1912

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
X	GMELIN: "Handbuch der Anorganischen Chemie, 8th edition, Verlag Chemie GmbH., Weinheim DE. * Page 545, part B, "Silicium"; page 340, part A, "Aluminium" *	1	C 22 C 1/02
X	COMPTES RENDUS DE L'ACADEMIE DES SCIENCES, vol. 216, 1943, pages 268-270 F. TROMBE et al.: "Chimie Minérale. - Possibilités de réactions de métaux fondus sur les oxydes métalliques" * Page 269, table *	1	
A	NL-B- 60 896 (I.G. FARBENINDUSTRIE A.G.) * Claim 1; page 1, lines 46-67; page 2, lines 7-16 *	1	TECHNICAL FIELDS SEARCHED (Int. Cl. ³)
A	GB-A-1 055 231 (MORGANITE RESEARCH AND DEVELOPMENT) * Page 2, example 2, lines 75-79 *	1	C 22 C 1/02 C 22 C 1/04
A	GB-A- 392 640 (WYDLER) * Claim 1; page 2, lines 3-4 *	1	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	23-08-1983	LIPPENS M.H.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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