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Datasheet for the decision of 27 April 2015

Case Number: T 2389/13 - 3.2.07

Application Number: 09793402.0

Publication Number: 2379777

IPC: C23C28/00, F01D5/28

Language of the proceedings: EN

Title of invention:
ENVIRONMENTAL BARRIER COATINGS PROVIDING CMAS MITIGATION CAPABILITY FOR CERAMIC SUBSTRATE COMPONENTS

Applicant:
General Electric Company

Headword:

Relevant legal provisions:
EPC Art. 54(1), 56
EPC R. 115(2)
RPBA Art. 15(3)

Keyword:
Oral proceedings held in the absence of the appellant
Novelty - (no)
Inventive step - (no)

Decisions cited:
T 1704/06

Catchword:

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Case Number: T 2389/13 - 3.2.07

D E C I S I O N
of Technical Board of Appeal 3.2.07
of 27 April 2015

Appellant: (Applicant)	General Electric Company 1 River Road Schenectady, NY 12345 (US)
Representative:	Szary, Anne Catherine GPO Europe GE International Inc. The Ark 201 Talgarth Road Hammersmith London W6 8BJ (GB)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 17 May 2013 refusing European patent application No. 09793402.0 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman	H. Meinders
Members:	H. Hahn
	G. Weiss

Summary of Facts and Submissions

I. The applicant lodged an appeal against the decision of the Examining Division to refuse the European patent application No. 09 793 402.0.

With its statement setting out the grounds of appeal the appellant requested that the decision be set aside and a patent be granted on the basis of the claims underlying the impugned decision, alternatively on the basis of amended claims which might be submitted in the course of the proceedings. In case the Board intended to confirm the decision to refuse the application, oral proceedings were requested.

II. The following documents of the examination proceedings are mentioned in the present decision:

D1 = WO-A-03/026886,
D2 = US-A-2006/0280963,
D3 = EP-A-1 683 773,
D4 = US-A-5 851 678,
D5 = US-A-2003/0035907,
D6 = US-B-6 602 814.

The following documents introduced by the Board are relevant for the present decision:

D7 = US-B-6 759 151 (cited in D2 and D3) and
D8 = Wikipedia, "Spinel group" (printout from http://en.wikipedia.org/wiki/Spinel_group dated 20 January 2015.

III. The Examining Division held that claim 1 of the single request dated 25 March 2013 met the requirements of Articles 123(2) EPC and its subject-matter was

considered to be novel over D1-D6. However, the subject-matter of claim 1 was considered to lack inventive step since the claimed compounds of the outermost layer of the environmental barrier coating (EBC) are considered picked out in an arbitrary manner from the numerous compounds and their iterations disclosed in the present application and it is not derivable which technical problem is solved, particularly in view of the teaching of D2. Therefore the application was refused under Article 56 EPC.

IV. Independent claim 1 of that request, underlying the impugned decision, reads as follows:

"1. An environmental barrier coating having CMAS mitigation capability for oxide components, the barrier coating comprising:

a transition layer comprising BSAS; and

an outermost layer selected from the group consisting of $ZnAl_2O_4$, $Ln_2Si_2O_7$ and Ln_2SiO_5, wherein Ln represents Sc, Y, La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu and mixtures thereof; and

wherein the transition layer is disposed between the oxide component and the outermost layer."

No alternative or auxiliary requests were filed.

V. With a communication annexed to summons for oral proceedings set for 27 April 2015 the Board presented its preliminary and non-binding opinion with respect to the claims of this single request.

The Board stated amongst others that it would be necessary to discuss in particular novelty over D7 and inventive step starting from either D2 or D7 and the common general knowledge of the person skilled in the art, as follows:

"*4. Novelty (Article 54 EPC)*

4.1 The Board considers that document D7 is relevant for novelty of the subject-matter of claim 1. D7 is cited in D2 in column 3, line 9 and in D3, column 7, line 56.

4.1.1 D7 discloses a multilayer article (e.g. a gas turbine component) having a low coefficient of thermal expansion outer layer. The article of D7 comprises a substrate comprising a ceramic or a silicon-containing metal alloy, an optional bond coat 16 between said substrate 10 and an intermediate layer 20, 22 which may comprise an optional chemical barrier layer 18 adjacent the overlying outer layer 12 (see column 2, lines 41 to 58; column 5, lines 6 to 37 and figure 1). The intermediate layer preferably comprises mullite (3 Al_2O_3 *.2* SiO_2*) and barium strontium aluminosilicate or BSAS (x BaO.(1-x) SrO.* Al_2O_3*.2* SiO_2*) (see column 3, lines 54 to 67). Suitable chemical barrier compounds include mullite,* HfO_2*,* $HfSiO_4$*, and a rare earth silicate, e.g.* Yb_2SiO_5 *(see column 6, lines 8 to 51). The outer layer can be a low CTE rare earth silicate with a rare earth element selected from the group consisting of Sc, Dy, Y, Ho, Er, Tm, Yb, Lu, Eu, Gd, Tb and combinations thereof, e.g. consisting of* Yb_2SiO_5 *(see column 6, line 57 to column 7, line 1). According to examples 1 and 2 substrates of sintered monolithic SiC and melt infiltrated (MI) SiC/SiC composites were coated with a*

multilayer coating comprising a mullite and BSAS intermediate coat and either Sc_2SiO_5, Er_2SiO_5, or an Yb_2SiO_5 top coat (see column 8, line 27 to column 9, line 23 and column 9, line 25 to column 10, line 5).

4.1.2 The aforementioned multilayer coatings of the coated articles resulting from the examples 1 and 2 appear to meet all the requirements of the subject-matter of claim 1 of the single request which therefore appears to lack novelty.

The single request therefore appears not to be allowable (Article 54(1) EPC)

5. Inventive step (Article 56 EPC)

Although the single request appears not to be allowable taking account of the aforementioned objections the Board makes the following remarks in case that a formally allowable request would be considered novel over D7.

5.1 Any discussion of inventive step will take account of the problem-solution approach based on the distinguishing features over the closest prior art. It appears that each of documents D2 and D7 can be considered as the closest prior art for a ceramic article having the claimed environmental barrier coating of claim 1.

5.2 D2 discloses a coating system for Si-containing materials, particularly those for articles exposed to high temperatures such as a metal silicide alloy, a metal matrix composite reinforced with SiC, SiN and/or silicon, etc. (see paragraph [0011]. The coating system exhibits improved resistance to corrosion from sea salt

and CMAS as a result of using aluminate compounds to protect silicate-containing layers of the coating system (see paragraphs [0007] and [0008]). The multilayer T/EBC system includes optional bond coat layers 16 and 20, an environmental barrier coating (EBC) 22, a thermal barrier coating (TBC) 18 overlaying the EBC and formed of a thermal-insulating material, and a transition layer 24 between the EBC and the TBC; preferred compositions of the innermost bond coat layers 16 and 20 are silicon and mullite, BSAS (barium strontium aluminosilicates) for the EBC layer (see figure 1 and paragraphs [0012] to [0015]). According to D2 the silicate-based EBC layer 22 is protected by the transitional layer 24 which is formed by a more corrosion-resistant compound, namely alumina and aluminates - which as compared to silicates such as mullite and BSAS offer better resistance to corrosion attack from sea salt and CMAS while also exhibiting a potentially higher temperature capability and low chemical interaction with BSAS - the latter of which includes such compounds as $YAlO_4$, ... $SrAl_2O_4$, $CaAl_2O_4$, ... $MgAl_2O_4$ ... (see paragraph [0016]). The composition of the transition layer 24, which can be entirely formed of said compound(s) is selected taking account of the CTE values of the other layers such as that of SiC, mullite, BSAS, etc. (see paragraph [0017]).

5.2.1 The subject-matter of claim 1 is thus distinguished over the aluminate embodiments/the teaching of D2 in that the outermost layer is selected from the group consisting of ***$ZnAl_2O_4$****, $Ln_2Si_2O_7$ and Ln_2SiO_5, wherein Ln represents Sc, Y, La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu and mixtures thereof.*

5.2.2 However, the present application is silent with respect to any effect of the selection of $ZnAl_2O_4$ in comparison to $MgAl_2O_4$ or the rare earth sorosilicates $Ln_2Si_2O_7$ (or double island silicates) or to those of the nesosilicates (or island silicates) Ln_2SiO_5 of the rare earth elements.

5.2.3 The aforementioned list of aluminates according to D2 includes three spinel compounds (i.e. $SrAl_2O_4$ having a melting point of 2015°C, $CaAl_2O_4$ having a melting point of 1870°C and $MgAl_2O_4$ being frequently used as refractory compound due to its high melting point of 2135°C) having the general formula AB_2O_4 so that the person skilled in the art by applying his common general knowledge and taking account of the chemical and physical properties of this specific aluminate type will consider trying out other commonly known aluminate spinel compounds such as for example $ZnAl_2O_4$ (having a melting point of 1950°C and a low CTE of 5.5 ppm/°C) as material for said transition layer 24 (see for example D8, page 1) in order to solve the objective problem of providing an alternative material with high temperature resistance. It appears that the person skilled in the art would thereby arrive at the subject-matter of claim 1 without inventive skills by only applying his common general knowledge.

5.3 An outermost layer according to claim 1 being selected from the group consisting of $Ln_2Si_2O_7$, wherein Ln represents Sc, Y, La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu and mixtures thereof would be novel over the disclosure of D7. However, the present application is silent with respect to any effect of the selection of these rare earth sorosilicates (or double island silicates) $Ln_2Si_2O_7$ in comparison to those of the

nesosilicates (or island silicates) Ln_2SiO_5 of the rare earth elements. The latter are those disclosed in and taught by D7, which are selected from the group consisting of Sc, Dy, Y, Ho, Er, Tm, Yb, Lu, Eu, Gd, Tb and combinations thereof (such as Sc_2SiO_5, Er_2SiO_5, Yb_2SiO_5, etc.).

5.3.1 The objective technical problem would therefore be considered to reside only in the provision of alternative coating materials.

5.3.2 It seems that the person skilled in the art by applying his common general knowledge would also consider applying the sorosilicates for having comparable properties as the nesosilicates. Therefore claim 1 appears to lack inventive step over D7 and the common general knowledge of the person skilled in the art."

VI. With letter dated 21 April 2015 the appellant stated that "Further to the summons to attend oral proceedings pursuant to Rule 115(1) EPC to be held on 27 April 2015 applicants do not intend to attend the oral proceedings and hereby withdraw their request for oral proceedings."

This letter did **not** contain any further arguments concerning the objections raised in the above mentioned Board's communication.

VII. Oral proceedings before the Board were held on 27 April 2015. As announced, the appellant did not attend so that the oral proceedings were continued in its absence in accordance with Rule 115(2) EPC and Article 15(3) RPBA. At the end of the oral proceedings the Board announced its decision.

Reasons for the Decision

1. The statement of the appellant in its letter dated 21 April 2015 that it withdraws its auxiliary request for oral proceedings (see point VI above) implies, as is constant jurisprudence (see Case Law of the Boards of Appeal, 7th edition 2013, III.C.2.3), that the appellant relies on its submissions in the written proceedings.

   Furthermore, although the appellant did not attend the oral proceedings the principle of the right to be heard pursuant to Article 113(1) EPC is observed since it only affords the opportunity to be heard and, by absenting itself from the oral proceedings, a party gives up that opportunity (see the explanatory note to Article 15(3) RPBA cited in T 1704/06, Reasons No 7.2, not published in OJ EPO; see also the Case Law of the Boards of Appeal, 7th edition 2013, III.C.3 to III.C. 3.1).

2. In its communication accompanying the summons for oral proceedings the Board, taking account of the written submissions of the appellant, raised objections under Articles 54 and 56 EPC against the single request, explaining why in the Board's opinion the subject-matter of claim 1 of this request lacks novelty over the disclosure of D7 and why it lacks inventive step over a combination of the teachings of either D2 or D7 and the common general knowledge of the person skilled in the art (see point V above).

3. The appellant did not reply in substance to these objections (see point VI above). Since there has been no attempt by the appellant to refute or overcome the

objections raised in the above communication, the Board sees no reason to depart from its preliminary opinion expressed therein.

4. With regard to the above, the Board concludes - for the reasons already set out in its annex to the summons (see point V above) - that the subject-matter of claim 1 of the single request lacks novelty (Article 54 EPC) and inventive step (Article 56 EPC).

5. Consequently, the single request is not allowable.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

R. Schumacher H. Meinders

Decision electronically authenticated