BL O/258/11

27th July 2011

PATENTS ACT 1977

APPLICANT General Electric Company

ISSUE Whether patent application number GB 0611268.4 complies with section 1(1)(b) of the Patents Act

HEARING OFFICER H Jones

DECISION

Introduction

1 UK Patent application GB0611268.4 entitled "Bond coat for silicon-containing substrate for EBC and processes for preparing the same" was filed by General Electric Company on 8th June 2006 with an earliest priority date of 13th June 2005. The application was published as GB2427204 on 20th December 2006.

2 Despite amendment of the claims, the examiner has maintained that all of the claims lack an inventive step as they would be obvious to a person skilled in the art. The applicant disagreed and requested a hearing to decide the matter. The hearing took place via video link on 21st July 2011 where the applicant was represented by Anne Szary of General Electric International's patent operation.

The application

3 The application relates to a gas turbine component comprising a silicon-containing substrate and a bond coat layer directly overlying the substrate. The bond coat layer consists of a metal silicide selected from a group of various transition and lanthanide metals. The bond coat has the purpose of effectively adhering an environmental barrier coating (EBC) to the silicon containing substrate, even when the EBC is exposed to high operating temperatures in the excess of 1204ºC. The EBC protects the silicon containing substrate against oxidation and degradation.

Claims

4 I have made my decision on the basis of the amended claims filed on 24 March 2011.

5 Claim 1 reads:

> *A gas turbine engine component exposed to a high temperature corrosive environment (10) comprising:*
>
> *a silicon-containing substrate (30); and*
>
> *a bond coat layer (42) overlying the substrate (30), wherein the bond coat layer consists of a metal silicide selected from the group consisting of titanium trisilicide, chromium trisilicide, hafnium disilicide, gadolinium disilicide, lanthanum disilicide, neodymium silicide, ytterbium trisilicide, or a compatible combination thereof.*

The law

6 The examiner has argued that the invention does not involve an inventive step as required by section 1(1). The relevant sections of the Act read as follows:

> *1(1) A patent may be granted only for an invention in respect of which the following conditions are satisfied, that is to say –*
>
> *(a) it is new*
>
> *(b) it involves an inventive step*
>
> *….*
>
> *2(1) An invention shall be taken to be new if it does not form part of the state of the art.*
>
> *2(2) The state of the art in the case of an invention shall be taken to comprise all matter (whether a product, a process, information about either, or anything else) which has at any time before the priority date of that invention been made available to the public (whether in the United Kingdom or elsewhere) by written or oral description, by use or in any other way.*
>
> *3. An invention shall be taken to involve an inventive step if it is not obvious to a person skilled in the art, having regard to any matter which forms part of the state of the art by virtue only of section 2(2) above (and disregarding section 2(3) above).*

7 In *Windsurfing International Inc. v Tabur Marine (Great Britain) Ltd*[1] the Court of Appeal formulated a four-step approach for assessing whether an invention is obvious to a person skilled in the art. This approach was restated and elaborated upon by the Court of Appeal in *Pozzoli SPA v BDMO SA*[2], where Jacob LJ reformulated the Windsurfing approach as follows:

> 1a) Identify the notional "person skilled in the art".
> 1b) Identify the common general knowledge of that person.
> 2) Identify the inventive concept of the claim in question or if that cannot be readily done, construe it.

[1] [1985] RPC 49
[2] [2007] EWCA Civ 588

3) Identify what, if any, differences exist between the matter cited as forming part of the "state of the art" and the inventive concept of the claim or claim as construed.
4) Viewed without any knowledge of the alleged invention as claimed, do those differences constitute steps that would have been obvious to the person skilled in the art or do they require any degree of invention?

8 In assessing whether the invention claimed in the present application involves an inventive step, I will therefore use this *Windsurfing/Pozzoli* approach.

Arguments and analysis

9 In her examination report of 24th December 2010, the examiner identified the person skilled in the art as a development engineer in the field of protective coatings for use in high temperature corrosive environments. The skilled person would possess a background in chemistry, in addition to knowledge of the properties of materials commonly used in high temperature corrosive environments. Since this has not been challenged, I am happy to accept this interpretation.

10 As noted above, the application relates to a gas turbine component comprising a silicon-containing substrate and a bond coat layer overlying the substrate. The bond coat layer consists of a metal silicide selected from the group consisting of titanium trisilicide, chromium trisilicide, hafnium disilicide, gadolinium disilicide, lanthanum disilicide, neodymium silicide, ytterbium trisilicide, or a compatible combination therof.

11 The examiner has identified the following patent documents as the closest prior art:

D1: US 6759151 B1 to Lee
D2: US 2005/0079343 A1 to Raybould et al.

Both of these documents were published before the priority date of the application and so form part of the state of the art by virtue of section 2(2).

12 LEE and RAYBOULD are both directed to multi-layer articles comprising a silicon-based substrate. Protective coatings are applied to the substrate to allow the articles to be used at high operating temperatures. The documents both specify that the multi-layer article may be a gas turbine engine component.

13 In LEE, a bond coat is disposed directly over the substrate. At column 6 lines 13-18, LEE states that "a bond layer which comprises a silicon-containing metal alloy having a melting point above the melting point of silicon may be used, such as Mo-Si alloy and Nb-Si alloy. Suitable bond layer compositions would be apparent to those skilled in the art in view of this disclosure." LEE therefore teaches the use of silicon metal alloys (otherwise known as silicides) in general to raise the melting point of the bond layer. Molybdenum and niobium silicides are given as examples of metal silicides that may be used.

14 RAYBOULD, at paragraph 006, discloses "a component including a silicon-based substrate and a braze-based coating disposed on the silicon-based substrate. The braze-based coating includes a brazed layer disposed directly on the silicon-based substrate. The brazed layer includes an intermetallic compound, wherein the intermetallic compound comprises silicon and an element such as tantalum, molybdenum, scandium, ytterbium or yttrium." It is considered that the skilled person

would understand from this that the brazed layer includes a coating of silicon-metal compounds, i.e. silicides, where the metal may be tantalum, molybdenum, scandium, ytterbium or yttrium, but equally, an alternative metal may be used.

15 Ms Szary questioned the relevance of the term “brazed” in the context of this disclosure, and queried the impact that it would have on the skilled person’s interpretation of RAYBOULD. The term “brazing” is commonly used to refer to a metal-joining process where a filler metal/metal alloy is heated above its melting point. I consider that the skilled person would understand the “brazed layer” to be a layer that is formed by melting a metal or metal alloy. This is supported by paragraphs 0044-0045 of Raybould that describe coating the silicon-containing substrate with powdered metals before raising the temperature above the melting point of silicon to form the intermetallic layer. Since the layer is used to join or bond other surfaces together, I believe the term “brazed layer” in RAYBOULD would be construed by the skilled person as equivalent to a bond coat layer.

16 At paragraph 008, RAYBOULD goes on to list a range of specific silicides that may be used in the brazed layer including $TaSi_2$, Ta_5Si_3, Ta_2Si, $MoSi_2$, Mo_5Si_3, ScSi, Sc_5Si_3, YbSi, $YbSi_{1.8}$, Yb_3Si_5, Yb_5Si_3, YSi, Y_3Si_5 and Y_5Si_3.

17 The difference between the state of the art and the inventive concept of claim 1 is that the prior art teaches a bond coat layer consisting of silicides in general (and giving some examples), whereas claim 1 specifies particular metal silicide compounds, e.g. titanium trisilicide. The question to be answered is whether it would be obvious to the skilled person to use one of the specific silicides listed in claim 1 as a bond coat layer on a silicon-containing substrate.

18 Ms Szary argued that there is nothing to lead the skilled person to use the particular silicides detailed in claim 1. In her view, the reference in LEE to the use of a metal silicide bond coat would appear to be almost an incidental comment, since silicon is used as the bond coat in all six examples provided. Further, the focus of LEE is on the other layers making up the multi-layer article, not on the bond coat. The bond coat is described as being optional in LEE. Ms Szary had similar issues with RAYBOULD: that RAYBOULD discloses several exemplary silicides and there would be nothing to lead the skilled person to use one of the different silicides listed in claim 1.

19 In making my decision, it is noted that the compounds listed in claim 1 do not have any special characteristics associated with them that distinguish them from the long list of possible metal silicides provided on pages 8 and 9 of the description as filed. As such, there does not appear to be any invention in selecting these particular compounds from a larger group comprising metal silicides in general.

20 A skilled person in reading LEE would understand that a bond coat may comprise a metal silicide, and that the choice of the particular metal was not critical, so long as it results in the silicide having a melting point above that of silicon. LEE purposely points to the use of a wide range of sililcides when it says “suitable bond layer compositions would apparent to those skilled in the art”. Furthermore, LEE also teaches that a silicide bond coat will be more resistant to high temperatures than conventional silicon bond coats.

21 Similarly, the skilled person would understand that from RAYBOULD that a range of metal silicides could be selected to form the bond coat layer and the layer would help

the silicon-containing substrate to withstand the harsh conditions it is exposed to in its function as a gas turbine engine component.

22 The bond layers in both LEE and RAYBOULD have the same purpose as the bond coat layer of claim 1, and would have very similar high temperature properties. The skilled person would, as part of their common general knowledge, appreciate that other refractory metals could be substituted for the suggestions given in Lee/Raybould, including those specified in claim 1 of the invention. It would therefore be obvious to try the silicides of claim 1 and there would be a high expectation that these silicides would provide an effective bond coat in the high temperature environment of a gas turbine engine.

23 We then went on to discuss dependent claims 2 to 6. Claim 2 requires that the bond coat layer has a thickness of from 13 to 254 microns. Bond coat layers having dimensions within this range are disclosed in column 8 line 39 of LEE and paragraph 0027 of RAYBOULD.

24 Claim 3 is directed to a gas turbine engine component comprising an environmental barrier coating adjacent to and overlying the bond coat layer, which again is disclosed in both the prior art documents.

25 Claims 4 and 5 relate to the environmental barrier coating comprising an outer steam-resistant barrier layer consisting of at least 90% by weight alkaline earth silicate / aluminosilicate and at least 90% by weight barium strontium aluminosilicate respectively. Ms Szary acknowledged that this type of outer barrier layer is known and typical in turbine engine components.

26 Claim 6 is directed to the structure of the environmental barrier coating and requires that the EBC comprises an inner silica scale layer overlying the bond coat layer; an intermediate layer overlying the inner layer and comprising mullite, or a combination of mullite with a barium strontium aluminosilicate, a yttrium silicate, or a calcium aluminosilicate; and an outer barrier layer overlying the intermediate layer. This environmental barrier structure is disclosed in LEE.

Conclusion

27 I have found that the invention defined in claims 1 to 6 does not involve an inventive step and so I refuse the application under section 18(3).

Appeal

28 Under the Practice Direction to Part 52 of the Civil Procedure Rules, any appeal must be lodged within 28 days.

H JONES

Deputy Director, acting for the Comptroller