Intellectual Property Office

BL O/0671/25

22 July 2025

PATENTS ACT 1977

APPLICANT	Dr Andre Clark
ISSUE	Whether application GB2103155.4 complies with Section 14(3) and Section 1(1)(b) of the Patents Act 1977 (as Amended)
HEARING OFFICER	Dr Stephen Brown

DECISION

Background

1 Application GB2103155.4, titled "A toothbrush that has bristles made of, or incorporates, Borophene" was filed on the 7th March 2021 by Dr Andre Clark. The application was published as GB 2605359 on the 5th October 2022. The first Examination Report, issued under S18 of The Patents Act 1977 (As amended) herein after referred to as "the Act", was issued on the 20th August 2024. An objection to the application was raised under S14(3) of the Act. Attempts were made by the applicant to address the objection in this report by amending the application, but the amendments filed were rejected since they added matter contrary to S76(2) of the Act. The applicant presented arguments in their letter of 2nd December 2024 and a further Examination report under S18(3) was issued on the 30th January 2025 in response to these arguments. A Hearing was offered to the applicant at that point. The applicant accepted the offer of the Hearing and the matter came before me on the 28th May 2025.

The application

2 The application relates to the use of borophene for making the bristles, or other cleaning parts, of a toothbrush. Borophene is a crystalline atomic monolayer of boron which was first predicted by theory in the 1990s and was then experimentally confirmed in 2015. It is known to be stronger than graphene and, in some configurations, is also more flexible than graphene.

3 The application as filed contained 3 claims. Claim 1 of the application is as follows:

"A toothbrush in which the bristles (or other part of a toothbrush designed to come in to contact with teeth and gums to facilitate their cleaning) are made of, or incorporate Borophene"

4 For brevity, I shall henceforth use the expression "bristles" to mean "bristles or other part of the toothbrush designed to come in to contact with teeth and gums to facilitate their cleaning". I note that this approach is consistent with how the examiner and the applicant have been using the expression when discussing the matter disclosed in the application.

5 I believe that claim 1 is clear and can simply be construed as:

6 "A toothbrush with bristles which are comprised of borophene"

7 As the claim is silent on the quantity of borophene used, I construe it to cover bristles with any non-zero amount of borophene up to, and including, 100% borophene bristles.

8 This construction of claim 1 is reinforced by the 2nd paragraph of the description which states that:

… Borothene has the potential to be very resistant to wear and tear, and therefore either by itself or in combination (composite) with other chemicals to produce significantly longer lasting bristles…

9 Claim 2 of the application is appended to claim 1 and requires that the bristles are made of strands of borophene, or of a composite that includes borophene. Claim 3 of the application is also appended to claim 1 and requires that the bristles are made of strands of borophene, or of a composite that includes borophene and that the strands are woven or spun together. Claims 2 and 3 are also clear and present no problems in terms of their construction.

10 It is also worth noting at this point that the description as filed is only 1¼ pages long. It does not contain any detailed instructions on how the invention may be manufactured and simply proposes general methods that may be used, without giving any specific details.

11 Only a single drawing was filed and it appears to be a normal toothbrush but with the bristles presumably comprising borophene. It adds nothing to the understanding of the invention beyond what is disclosed in the description. The figure is as follows:

Figure 1.

The Law

12 Section 14(3) of the Act reads:

> *The specification of an application shall disclose the invention in a manner which is clear enough and complete enough for the invention to be performed by a person skilled in the art.*

13 The principles to be applied when assessing whether the specification satisfies this section of the Act are set out by Kitchin J in *Eli Lilly*[1]:

> *The specification must disclose the invention clearly and completely enough for it to be performed by a person skilled in the art. The key elements of this requirement which bear on the present case are these:*
>
> *(i) the first step is to identify the invention and that is to be done by reading and construing the claims;*
>
> *(ii) in the case of a product claim that means making or otherwise obtaining the product;*
>
> *(iii) in the case of a process claim, it means working the process;*
>
> *(iv) sufficiency of the disclosure must be assessed on the basis of the specification as a whole including the description and the claims;*
>
> *(v) the disclosure is aimed at the skilled person who may use his common general knowledge to supplement the information contained in the specification;*
>
> *(vi) the specification must be sufficient to allow the invention to be performed over the whole scope of the claim;*
>
> *(vii) the specification must be sufficient to allow the invention to be so performed without undue burden."*

14 Specific guidance to examiners is provided at paragraph 14.61[2] of the Manual of Patent Practice (MoPP). This states that there are three forms of insufficiency:

> *Classical Insufficiency: This arises where the teaching of the patent does not enable the skilled person to perform the invention.*
>
> *Insufficiency due to ambiguity/uncertainty: Where the disclosure is so ambiguous as to make it impossible to know whether one had worked the invention or not.*
>
> *Insufficiency due to excessive claim breadth: Where the disclosure isn't sufficient for the full breadth of the claims.*

---

[1] *Eli Lilly v Human Genome Sciences [2008] RPC 29*

[2] https://www.gov.uk/guidance/manual-of-patent-practice-mopp/section-14-the-application#ref14-61

15 Sufficiency is decided based on the facts at the date that the application was filed. The legal construct of the "skilled person" is used in determining whether the application is sufficient. The "skilled person" is an uninventive, but technically competent person who possesses the common general knowledge of the relevant technical art at the time that the application was filed and has the necessary skill and expertise to apply that knowledge. For the purposes of sufficiency, the skilled person is seeking to make the patent work and they can carry out routine experimentation, provided that there is no undue burden.

16 It is common ground that the invention defined in the claims is novel (new) but I also need to consider whether or not the claims define an invention which provides the required inventive step. Sec. 1(1) of the Act states:

> *A patent may be granted only for an invention in respect of which the following conditions are satisfied, that is to say*
> *(a) the invention is new;*
> *(b) it involves an inventive step;*
> *(c) it is capable of industrial application;*
> *(d) the grant of a patent for it is not excluded by subsections (2) and (3) or section 4A below; and references in this Act to a patentable invention shall be construed accordingly*

17 Sec. 3 of the Act goes on to say:

> *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).*

18 Sec. 2(2) of the Act states that:

> *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.*

19 The specific process to assess inventive step was set-out by the Court of Appeal in *Windsurfing*[3] in which the court formulated a four step process. This process was re-formulated by Jacob LJ in the Court of Appeal decision of *Pozzoli*[4] as follows:

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

---

[3] *Windsurfing International Inc. v Tabur Marine (Great Britain) Ltd, [1985] RPC 59*
[4] *Pozzoli SPA v BDMO SA [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 the claim as construed;

(4) Viewed without any knowledge of the alleged invention as claimed, do those differences constitute steps which would have been obvious to the person skilled in the art or do they require any degree of invention?

20 I will follow the processes set out in *Eli Lilly*[1] and *Pozzoli*[4] to assess whether or not the invention defined in the application is sufficiently disclosed and provides the required inventive step, respectively.

Arguments presented and assessment

21 In their letter of the 4th April 2025, the examiner argued that:

The second paragraph on the first page of the description proposes the use of borophene, either by itself or as part of a composite, to form toothbrush bristles. Claim 1 requires a toothbrush in which the bristles are made of or incorporate borophene. However, there is no discussion in the application about how exactly these bristles would be formed. The description as filed provides only that producing single extruded strands of borophene may not prove possible in the same way that nylon strands are produced, and that weaving or spinning may be required. I therefore consider that there is not enough information in the description to enable the skilled person to be able to make toothbrush bristles entirely of borophene, and neither is forming of these bristles such a well-known concept that it would form part of the skilled person's common general knowledge. In respect of bristles made from a composite containing borophene, the specification does not provide an embodiment to show what materials might make up the composite, and how such a composite would be manufactured into toothbrush bristles. I consider that an undue burden would be placed on the skilled person in trying to work the invention. Being mindful of the test in Edison and Swan Electric Light Co v Holland, I consider that a person of reasonably competent skill following the directions in the specification would have to find out something new in order to succeed, and therefore the disclosure is not complete enough.

22 However, at the Hearing, Dr Clark argued that the application relates to a "simple idea", i.e. the use of borophene in making toothbrush bristles. He argued that the amount of borophene to be added could be determined by a simple matter of "routine trial and error". All that is required by the invention is that the bristles contain *some* borophene.

23 Dr Clark argued that adding a small amount of borophene to a known composite used for making toothbrush bristles was a trivial step that any competent industrial chemist would be capable of carrying out since it could be done in much the same way that graphene is currently used in manufacturing bristles for toothbrushes. A small amount of borophene, he argued, would provide the anticipated benefits that the invention envisages, specifically that borophene *"has the potential to be very*

resistant to wear and tear and… produce significantly longer lasting bristles… and thereby reduce the environmental damage associated with the use of toothbrushes". Indeed, Dr Clark argued that the skilled person would recognise that only small fractions of borophene should be used and that the skilled person would be able to readily manufacture bristles containing a small fraction of borophene using the same processes as used for non-borothene bristles.

24 This argument has some merit and I accept it at face value inasmuch as it relates to a small amount of borophene. I thus conclude that the application does not suffer from classical insufficiency, as defined above, since it is possible for the skilled person to make *one embodiment* of the invention. Namely, the embodiment using an amount of Borothene small enough that traditional bristle manufacturing methods may still be used.

25 However, as I have observed above, claim 1 is not limited to only a small amount of borophene. It encompasses *any* amount of borophene, up to and including 100%. The application is silent on a process that may be used to manufacture bristles having a high proportion of borophene, other than stating, at the top of page 2 of the description, that:

> *… other means such as weaving or spinning may (or may not) need to be employed…*

26 In fact, at the hearing, Dr Clark argued that the skilled person would know not to use a high proportion of borophene. However, the claim is not limited in this way.

27 Following *Eli Lilly*[1], the specification must be sufficient to allow the invention to be performed over the whole scope of the claim without undue burden. That is clearly not the case here, as producing bristles with a high borothene content would, I believe, require extensive research. I thus conclude that the application is insufficient due to excessive claim breadth.

28 For the sake of completeness, I will now consider the situation where only a small proportion of borophene is used. As noted above, I am happy to accept that the skilled person would be able to make such an embodiment in much the same way that graphene is used at present. I will therefore consider whether or not this embodiment would be obvious at the filing date of the application. I shall do this following the 4 step process set out in *Pozzoli*[4].

29 In their letter of the 4th April 2025 the examiner stated that, when considering step 1 of the process set out in *Pozzoli*:

> *"…the skilled person is considered to be a person involved in the manufacture of toothbrushes and their common general knowledge would include knowledge of the chemical and mechanical processes involved in the manufacturing of toothbrushes, and knowledge of the properties of the materials used in making the different components of toothbrushes. It is known in the art for graphene to be used to produce toothbrush bristles with increased wear resistance, and as you have highlighted in your letter of 2nd December 2024 there is overlap between graphene and borophene research. I therefore consider that the skilled person would also be aware of borophene and its properties which include its strength."*

30 I will, however, depart from this view as I regard the skilled person as being an industrial chemist rather than a manufacturer of toothbrushes since the invention appears to relate to the chemical composition used in manufacturing the bristles of a toothbrush rather than a toothbrush as such. At the hearing, Dr Clark did not object to such a characterisation of the skilled person.

31 The skilled person would therefore be very familiar with the basic elements and their properties. Dr Clark argued that, although boron and carbon are very close in the periodic table and could therefore be expected to have similar properties, an industrial chemist would not think of the location of elements in the periodic table when considering their properties. He argued that an industrial chemist would have other ways of considering the properties of elements. However, the periodic table specifically groups together elements that behave in similar ways due to their atomic structures. Not only would an industrial chemist know the general location of a given element in the periodic table, they would also recognise the significance of its location. Given the proximity of boron and carbon on the periodic table, an industrial chemist would recognise that borophene and graphene should have similar properties. Research has confirmed that this is the case and at the filing date of the invention it was known that borophene was stronger and, in some forms, more flexible than graphene.

32 Regarding step 2 of the *Pozzoli* approach I regard the invention as being the inclusion of borophene in the composite used to manufacture the bristles of a toothbrush.

33 In considering step 3 of the *Pozzoli* approach, the examiner cited 3 documents, each disclosing toothbrushes having bristles that contain graphene. These documents are:

GB 2 541 378 A (Clark);

CN1081 13200 A (Jiangsu College); &

CN1072 59774 A (Jinan Electronic Products Co. Ltd.).

34 The invention differs from these in that borophene is used in the bristles in place of graphene.

35 Finally, I must consider step 4 of the *Pozzoli* approach. In their letter of the 4th April 2025, the examiner stated that:

"…there is overlap between borophene and graphene research, and the skilled person would recognise borophene as a potential substitute for graphene without requiring any inventive thought."

36 I agree with this conclusion. The skilled person, as noted above would be well aware of borophene, its properties and its potential benefits, specifically that it is stronger and more flexible than graphene. In his arguments, Dr Clark stated that the problems associated with the use of graphene, specifically that it can be brittle, are not recognised and that there is no evidence that borophene has been used so far in manufacturing the bristles of toothbrushes. Neither of these points is really relevant in this instance. I note that the skilled person would know that graphene may be

brittle. The skilled person would also recognise that using borophene could result in a superior product in terms of strength and flexibility and would therefore be minded to try it.

37 The second argument presented by Dr Clark can be summarised as “if it is obvious, why has no one done it before?”. This effectively amounts to no more than arguing that the claims are novel. This is acknowledged to be the case, but it is not an indicator that the invention is also inventive. Indeed, the Manual of Patent Practice at paragraph 3.78 reminds examiners that:

“The fact that no-one has followed a particular path before does not of course dispose of an obviousness objection, otherwise any invention which was new would automatically be inventive.”

38 The relevant procedure is to follow the steps set out in *Pozzoli*. Having followed these steps, I conclude that the invention defined in the claims does not provide the required inventive step. Thus, even if Dr Clark were to limit the claims to bristles with a small proportion of borophene to bypass the issue of sufficiency, the resultant claims would be obvious.

Conclusions

39 Having fully considered the application, I conclude that the specification is insufficient in that it does not enable the skilled person to work the invention over the full breadth of the claims. Where the skilled person is able to work the invention, it does not provide the required inventive step. Having reviewed the application, I do not consider that any saving amendment is possible. I therefore refuse this application under section 18(3).

Appeal

40 Any appeal must be lodged within 28 days after the date of this decision.

Dr STEPHEN BROWN

Patent Examination Group Head