Patents Act 1977 **Opinion Number** **22/18**

OPINION UNDER SECTION 74A

Patent	EP 2121236 B1
Proprietor(s)	Element Six Technologies Limited
Exclusive Licensee	
Requester	Renishaw plc
Observer(s)	
Date Opinion issued	05 December 2018

The request

1. The comptroller has been requested by Renishaw plc ("the requester") to issue an opinion as to whether EP 2121236 B1 ("the patent") is valid under section 74A of the Patents Act 1977 in terms of the following:

   (a) whether the subject matter of claims 6-14 of the patent is new and/or inventive and hence these claims define a patentable invention; and

   (b) whether the specification discloses the invention of claims 6-11 clearly and completely enough for it to be performed by a person skilled in the art.

2. The requester has provided the following evidence to accompany the request:

   A1: GB 2243688 A (DE BEERS)

   A2: EP 1079201 A2 (RENISHAW)

   A3: "Styli Ball grading" (RENISHAW)

   A7: WO 03/016240 A2 (ELEMENT SIX)

   A9: US 5458827 A (HOLLY)

   A10: US 6410877 A (DIXON et al.)

   A11: WO 2007/007126 A1 (ELEMENT SIX)

   B1: WO 2006/043157 A2 (ELEMENT SIX)

B2: WO 2006/011028 A1 (ELEMENT SIX)

B3:"Low temperature growth of nanostructured diamond on quartz spheres", SA Catledge et al, Journal of Physics D: Applied Physics, Volume 38, Number 9, (2005) 1410-1414

B4: JP 2006-201105 A (MITUTOYO CORP.) including English language abstract from Patents Abstract of Japan (B4-PAJ) and also a machine translation (B4-MT)

B5: JP H04-76401 A (NORITAKE CO. LTD.) including English language abstract from Patents Abstract of Japan (B5-PAJ) and also a machine translation (B5-MT)

E1: Examination report dated 13 November 2009 issued during the EPO examination proceedings

E2: Examination report dated 22 July 2010 issued during the EPO examination proceedings

E3: Grounds of Appeal submitted by patentee following refusal of patentee's earlier single-crystal diamond EP application (application A11 above)

E4: Board of Appeal opinion relating to refusal of patentee's earlier single-crystal diamond EP application (allocation A11 above)

3. Each of the documents A1-A3, A7, A9-A10 and B1-B4 have a publication date prior to the priority date of the patent. A11 was published on the priority date of the patent. It has been published in the regional phase as EP 1902333 A1 which could be a novelty only prior art against the patent as it has an earlier priority date.

Observations

4. No observations were received.

Relationship of this Opinion to Opinion 13/18

5. The requester has already had an opinion, Opinion 13/18, on the validity of the patent. In Opinion 13/18 I gave my opinion that independent claim 1 and dependent claims 2-4 of the patent were anticipated by A9 and dependent claim 5 to lack inventiveness in light of A9.

6. However as detailed in the present request, this opinion relates to a number of documents and argument filed by the requester in their observations in reply in Opinion 13/18. This additional evidence was considered to not be strictly in reply to the observer's argument and was thus was not considered as part of the earlier opinion. As a result independent claim 6 and claims dependent thereon were determined to be novel and inventive in light of the evidence considered. Therefore this opinion request has been restricted to focus on the validity of claims 6-14 and the sufficiency of claims 6-11.

Allowance of the request

7. As I have already issued an opinion on the validity of the patent this raises the question as to whether the requester is seeking an opinion on any matter that was sufficiently considered by the earlier opinion.

8. Rule 94(1)(b) of the Patents Rules 2007 provides that:

> *The comptroller shall not issue an opinion if the question upon which the opinion is sought appears to him to have been sufficiently considered in any relevant proceedings.*

The "relevant proceedings" are defined in rule 92 as proceedings (whether pending or concluded) before the comptroller, the court, or the European Patent Office.

9. The requester has argued that their present request is a new request that raises questions not considered either in my earlier opinion or by the EPO during their examination proceedings. The requester states that evidence B1-B4 was not submitted as part of the earlier opinion or considered by the EPO. This is the case and I will consider the arguments put forward in relation to B1-B4.

10. A1-A3, A7 and A9-A11 were all submitted as part of the earlier opinion request. A1, A2, A10 and A11 were not considered in my earlier opinion as they were deemed to have been given due consideration by the EPO examiner during the examination process. The requester has argued that I should consider them as part of this request as they are now being used to argue the inventiveness of the claims based on combinations with B1-B4 or with each other in combinations not previously considered by the EPO of by myself. Again I agree with the requester and consider the argument put forward in relation to these documents to be new questions appropriate for me to consider in this opinion.

S.27 Amendment

11. Since the filing of this request, I note that the proprietor has made an application under section 27 to amend the claims of the patent. Proceedings under section 27 are ongoing and have not been concluded. The allowability of the proposed amendments is solely a matter for the ongoing section 27 proceedings. For the purposes of this opinion, I shall only consider the validity of the claims that were the subject of the request, namely the claims as granted.

The Patent

12. The patent, EP 2121236 B1, is titled "POLYCRYSTALLINE DIAMOND ELEMENTS HAVING CONVEX SURFACES; METHOD OF CUTTING A ROTATIONAL SYMMETRICAL SURFACE OF A DIAMOND ELEMENT USING A LASER; METHOD OF POLISHING A SPHERICAL SURFACE OF A POLYCRYSTALLINE OR COATED DIAMOND ELEMENT". It was filed on 18th January 2008 with a priority date of 18 January 2007, published on 25th November 2009 and granted on 15th August 2012. The patent remains in force.

13. The patent relates to a method of forming a rotationally symmetrical surface on diamond elements and to an element of diamond material for use as metrology tips.

14. In coordinate measuring machines (CMMs) or metrology tips, a spherical tip is mounted on a stem and used to measure or profile a workpiece. In metrology, spherical tips are used to map out the shape and roughness of surfaces made from metals, glasses, ceramics, crystalline, and other materials, whose surface shape needs to be measured with high accuracy. The tip is usually mounted on a partially flexible arm, which is fitted with a highly sensitive detector for sensing any flexing of the arm. Typically, movements of the order of a few nanometres can be detected. Conventionally, CMM probes are typically made from high chrome, high carbon, stainless steel.

15. In typical metrology applications, since the object to be measured is in general non-planar, different parts of the tip are in contact with the measurement object. In order to have a flexing of the measurement arm which is independent of the position on the tip, which is in contact with the object, the tip itself needs to be spherical to an accuracy which exceeds the accuracy of the motion so that the accuracy of the measurement is not adversely affected by the shape of the tip. Currently available tips suffer from the problem of wear, since the tip can be in continuous sliding contact with the surface of the object. Especially when hard and/or rough materials are measured, the wear of the tips leads to rapid deterioration of the spherical shape of the tip. This leads to measurement errors when using these tips. In such cases, the tip must be replaced by a new and undamaged tip. This leads to a high cost of measurement caused by the high cost of the tips and the need to recalibrate each new tip. Another common problem with softer materials such as aluminium is a build-up, even during a single measurement, of the material from which the measurement object is made on the surface of the tip, thus leading to measurement errors.

16. There is thus a great need for tool tips which are resistant to wear, resistant to the accumulation of detritus thereon and which can be caused to move over the surface under observation in a reliable continuous motion.

17. The inventors have established that diamond shows exceedingly low wear characteristics and would be an ideal material from which to manufacture metrology tips and/or measurement balls. Further advantages to the use of diamond are provided by its hardness and very low friction coefficient when in contact with most hard and soft materials, including diamond itself. They consider that this would make diamond the preferred material for use in a metrology tip or measurement ball. Key to this invention is the realization that a diamond surface, particularly a diamond surface with low surface Ra and Rq (roughness) and which is free of defects such as pits, digs and scratches, accumulates less material from the surface being measured, and thus provides a longer life.

18. Furthermore a particular advantage of diamond over conventionally used materials is that on aluminium, pick up is very much reduced i.e. the accumulation of material from the surface being tested is very much reduced. This is thought to be related to the low chemical reactivity of diamond.

19. In particular, it is an object of the invention disclosed in the patent to produce hemispherical or super-hemispherical surfaces on a diamond element suitable for

use as a tool tip in a metrology system. It is a further object of this invention to provide a method that addresses the problems in polishing diamond material to a required thickness to within high accuracy. Diamond spheres and super-hemispheres according to the invention can be formed in two ways, either from solid freestanding polycrystalline diamond, or by coating a different base material already in the form of a sphere or appropriate spherical segment.

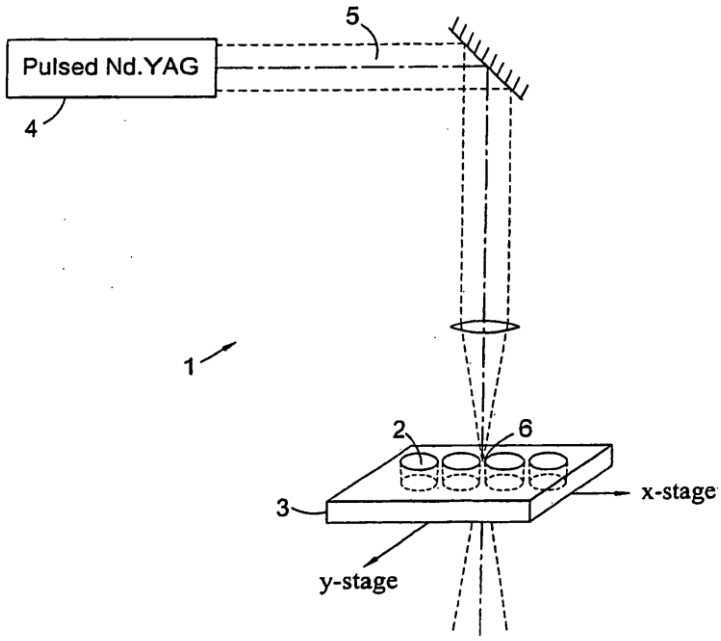

FIG. 1

20. Figure 1 is a schematic view of an apparatus 1 for cutting cylindrical sections 2 from a diamond plate 3 for use as blanks onto which spherical surfaces can be formed. The apparatus comprises an X-Y translation stage (not shown) onto which the diamond plate 3 is mounted. A cutting laser 4, for example a pulsed Nd:YAG laser, generates a light beam 5 which is focussed onto the diamond plate 3 and which has sufficient energy to cut the diamond of the plate. The diamond cylinder 2 is subsequently brazed with one of its flat sides onto a cylindrical rod 11.

21. The rod 11 is mounted in a high speed rotating spindle. The diamond cylinder 2 mounted on the rod 11 is positioned close to the focus 13 of a high power laser 14 so that the axis of rotation 12 of the spindle is perpendicular to the direction of the incoming laser light 15. The spindle is mounted on a translation stage so that the diamond cylinder 2 can be translated in two dimensions in a plane perpendicular to the direction of the incoming light, as shown in Figure 2C below. By translating the cylinder relative to the laser 14 as it is rotated, a shape can be cut out of the diamond that has rotational symmetry with respect to the rotation axis 12 of the spindle. If the translation follows the arc of a circle 16, the surface 10 cut into the cylinder 2 is spherical.

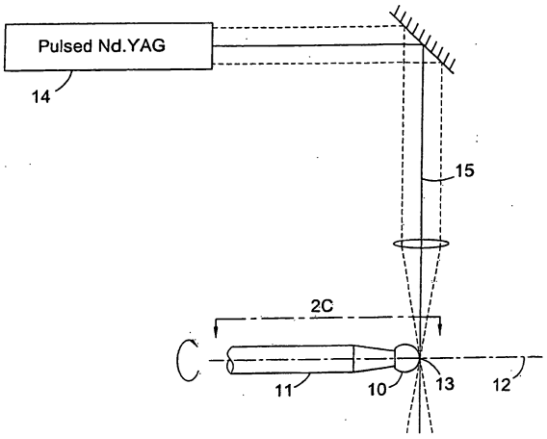

FIG. 2A

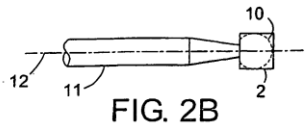

FIG. 2B

FIG. 2C

22. In the formed spherical surface, deviations from the ideal spherical surface are less than about 5 µm. The surface itself at this stage has a RMS roughness Rq of less than about 30 nm. Should the spherical surface not meet these characteristics for the sphericity and roughness of the element further polishing will be necessary.

23. Figure 3 below is a schematic view of an apparatus for polishing the spherical surface on a diamond element 2 to improve the characteristics. The element 2, still brazed to the rod 11, is mounted in a rotational stage 20, which rotates at a low rate of typically 0.1-100 rpm around the axis 12 of the rod 11. A high-speed rotary spindle 21 fitted with a polishing cup 22 is pressed against the rotating diamond element 2. The force with which this cup 22 is pressed against the sphere may be adjusted by a spring (not shown) and depends on the size of the element 2 to be polished.

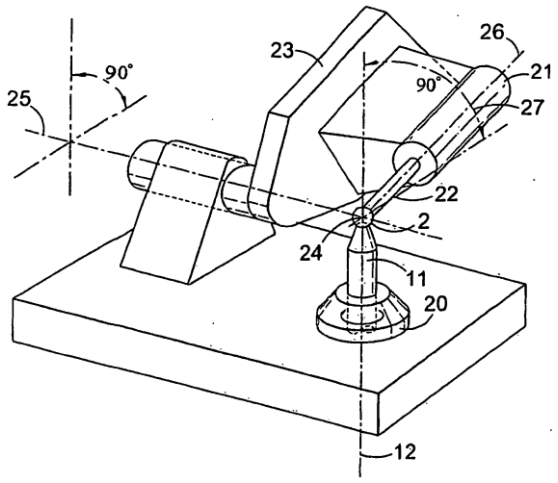

FIG. 3

24. The patent has fourteen claims including two independent claims – claims 1 and 6. As discussed above the requester has limited the scope of this opinion to consider the validity of claims 6-14. Independent claim 6 reads as follows:

> *6. An element of diamond material having a convex surface (10) formed thereon, wherein the diamond element is polycrystalline or the diamond element comprises base material which is coated with diamond, characterised in that the convex surface (10) having a root mean square roughness, Rq, of less than about 30 nm, the element further having at least one of the properties from the following list:*
>
> *(a) the convex surface (10) including a spherical segment having a conical halfangle greater than about 10°, for which the maximum peak to valley deviation from a perfect spherical surface is less than about 5 µm;*
>
> *(b) the convex surface (10) including a spherical segment having a conical halfangle greater than about 10° for which the RMS deviation of the spherical segment, as measured by averaging over the square of deviations over the spherical segment, is less than or equal to about 500 nm.*

The law

25. Section 1(1)(a) and (b) of the Patents Act (henceforth 'the Act') reads:

> *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) the invention is new;*
> *(b) it involves an inventive step;*

26. The relevant provisions in relation to novelty are found in section 2(1) and section 2(2) which read:

> *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.*

27. The provisions in relation to inventive step are found in section 3 which states:

> *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).*

28. The Court of Appeal in Windsurfing[1] 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[2]. Here, Jacob LJ reformulated the Windsurfing approach as follows:

> *(1)(a) Identify the notional "person skilled in the art"*
> *(1)(b) 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;*
> *(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 that would have been obvious to the person skilled in the art or do they require any degree of invention?*

29. Section 14(3) of the Act states:

> *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.*

Claim construction

30. I will begin by considering the validity of the invention as defined by independent claim 6. Only if I find claim 6 to be invalid will I consider the remaining dependent claims.

31. Before considering the documents put forward in the request I need to construe claim 6 of the Patent, that is to say I must interpret it in the light of the description and drawings as instructed by Section 125(1). In doing so I must interpret the claims in context through the eyes of the person skilled in the art. Ultimately the question is what the person skilled in the art would have understood the patentee to be using the language of the claims to mean. This approach has been confirmed in the recent decisions of the High Court in Mylan v Yeda[3] and the Court of Appeal in Actavis v ICOS[4].

32. Section 125(1) of the Act states that:

> *For the purposes of this Act an invention for a patent for which an application has been made or for which a patent has been granted shall, unless the context otherwise requires, be taken to be that specified in a claim of the specification of the application or patent, as the case may be, as interpreted by the description and any drawings contained in that specification, and the*

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[1] Windsurfing International Inc. v Tabur Marine (Great Britain) Ltd, [1985] RPC 59
[2] Pozzoli SPA v BDMO SA [2007] EWCA Civ 588
[3] Generics UK Ltd (t/a Mylan) v Yeda Research and Development Co. Ltd & Anor [2017] EWHC 2629 (Pat)
[4] Actavis Group & Ors v ICOS Corp & Eli Lilly & Co. [2017] EWCA Civ 1671

extent of protection conferred by a patent or application for a patent shall be determined accordingly.

33. The requester has argued that claim 6 can be construed as:

> (i) being directed merely to a polycrystalline diamond element having a surface roughness and sphericity over a spherical segment within certain arbitrary parameters;
>
> (ii) does not require those parameters to be achieved over the entire surface of a sphere, but only across a limited part of the element's surface (a conical halfangle as small as 10º); and
>
> (iii) is not limited to any particular method of manufacturing the polycrystalline diamond element.

34. Whilst I agree with the requester regarding points (ii) and (iii) above, I do not consider claim 6 to be necessarily directed to a polycrystalline diamond element. Claim 6 requires the diamond element to be polycrystalline or the diamond element comprises a base material which is coated with diamond. Paragraph [0029] and [0030] of the patent read as:

> *[0029] Diamond spheres and super-hemispheres according to the invention can be formed in two ways, either from solid freestanding polycrystalline diamond, or by coating a different base material already in the form of a sphere or appropriate spherical segment.*
>
> *[0030] The diamond material used for coating may be single crystal diamond material or polycrystalline diamond material and is preferably polycrystalline diamond material.*

35. In the alternative the diamond element can comprise a base material which is coated with diamond. As explained in paragraph [0030] above the diamond is not necessarily a polycrystalline diamond material. In my opinion point (i) should read as:

> (i) being directed merely to a polycrystalline diamond element or a diamond element comprising a base material which is coated with diamond having a surface roughness and sphericity over a spherical segment within certain arbitrary parameters.

36. As described in point (ii) above claim 6 requires the parameters set out in the claim to be achieved over a conical halfangle as small as 10º i.e. a 20º segment.

37. In my opinion claim 6 is clear and straightforward and a person skilled in the art would have no difficulty in construing the scope of the claim.

38. I will consider the construction of the dependent claims if necessary following my assessment of the validity of claim 6.

Does B1 disclose all of the features of claim 6?

39. The requester argues that B1 discloses all of the features of claim 6. B1 discloses a method of producing a diamond coated surface on a substrate. Producing the diamond-coated surface on a substrate involves preparing a surface of the substrate by exposing it to a power beam to increase the surface roughness; and applying a diamond layer (e.g. polycrystalline) to the prepared surface. The power beam is a laser beam or other electromagnetic beam, or an electron beam or other particle beam. The diamond layer is deposited on the substrate surface by chemical vapour deposition. By increasing the surface roughness adhesion of the diamond layer applied to the prepared surface is increased.

40. The requester draws attention to "Example 3" which reads as follows:

> *In this example, a high purity tungsten substrate shaped into a 270º segment of a sphere (radius approximately 18 mm) is coated in a hot filament CVD system, with the intention of using it as a femoral head in a replacement hip joint.*
>
> *Although tungsten is a very good substrate for CVD diamond synthesis, adhesion between the diamond layer and the substrate can be a problem, and in situations where the reliability of adhesion is essential, steps must be taken to ensure that adhesion is maintained. In this example, the substrate surface was subjected to a power beam treatment to form a more-or-less regular array of protrusions from the surface. The protrusions were typically 50-80 µm tall with a diameter of 30-50 µm. The substrate was subsequently seeded and cleaned as disclosed in Example 1.*
>
> *The substrate was coated with a layer of diamond in a hot filament chemical vapour deposition system with a tantalum filament array configured for uniform deposition over a part sphere. The conditions used were a hydrogen, 1% methane gas mixture at a total flow rate of between 600 and 700 sccm, a chamber pressure of 6.5 x 10^3 (50 Torr) and a filament temperature measured using an optical pyrometer of between 1700ºC and 1900ºC. A substrate temperature of 830ºC was maintained by adjusting the cooling to the substrate. Growth was continued until the layer thickness was between 150 and 200 µm.*
>
> *On removal from the deposition system, the CVD diamond layer was found to be well adhered. The layer was subsequently processed by lapidary techniques to a surface roughness, as characterised by its Ra, of better than 20 nm and a sphericity of better than 10 µm. During processing there was no evidence of delamination. In contrast, part spheres without the structured surface can similarly be coated with CVD diamond, but it is usually found that there is at least some delamination during processing.*

41. Example 3 discloses an element of diamond material having a convex surface formed thereon, wherein the diamond element is comprises a base material (tungsten) which is coated with diamond.

42. The surface roughness Ra is given as better than 20nm i.e. 0-20nm. Paragraph

[0020] of the patent gives the relationship of surface roughness Ra to root mean square roughness Rq as:

> *The root mean square surface roughness, Rq, is related to the average surface roughness, Ra, such that for a Gaussian distribution of deviations from the mean, Rq is equal to 1.25 Ra.*

Using this relationship Example 3 discloses the element having a root mean square roughness Rq of better than 25nm i.e. 0-25nm. Claim 6 requires the root mean square roughness Rq to be less than about 30nm.

43. Example 3 also discloses the convex surface including a spherical segment of 270° having a sphericity of better than 10µm i.e. 0-10µm. B1 does not include an explicit definition of the term “sphericity” but the requester argues that the term is a common term in the art and it is reasonable to consider that the term is meant in the same or at least a similar way to what is stated in paragraph [0024] of the patent:

> *The term "sphericity" as used herein defines the maximum deviation of the surface from that of a perfect sphere. More specifically, the sphericity provides a measure of the maximum distance of a point on the spherical surface being measured from the position that the point in question would be in if the surface was the surface of a perfect sphere.*

I agree with the requester on this point and in my opinion a person skilled in the art would understand the term “sphericity” upon reading B1 to mean as defined above. Part (a) of claim 6 requires the segment of the convex surface to have a maximum peak to valley deviation from a perfect spherical surface of less than about 5 µm. B1 discloses this deviation to be 0-10 µm.

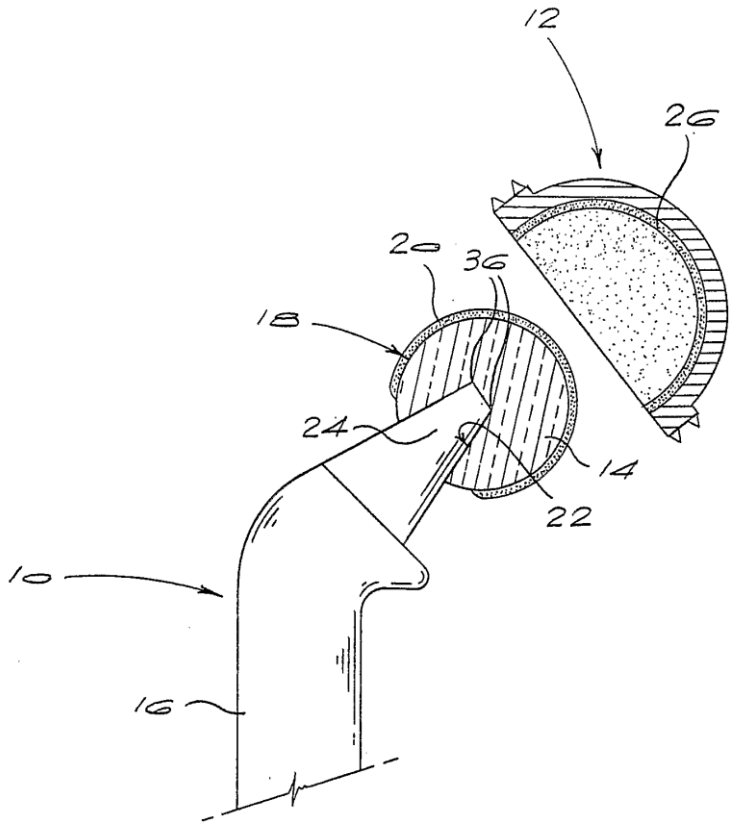
44. Therefore, as only one of the two alternatives given in claim 6 needs to be disclosed, in my opinion claim 6 is not novel in light of B1.

Does B2 disclose all of the features of claim 6?

45. B2 discloses (as illustrated below) a prosthetic joint component, typically a hip joint component such as a ball 14 or a socket 12, consists generally of a substrate material with a generally non-planar surface and a layer 20 of wear-resistant material on a surface thereof presenting a bearing or wear-resistant surface for the component. The substrate is tungsten metal, an alloy of tungsten, molybdenum, an alloy of molybdenum, or combinations thereof. The wear resistant material is preferably polycrystalline CVD diamond.

46. On page 3 of B2 describes a preferred embodiment of the invention as being a prosthetic joint component characterised by having one or more of the following shape tolerances: .

> *- sphericity of +/- 5 µm,*
> *- radius of +/- 10 µm, and*
> *- roughness preferably <40 nm Ra and more preferably < 20 nm Ra.*



47. As with B1, B2 does not include an explicit definition of the term “sphericity”. Again I consider the person skilled in the art would understand the term “sphericity” upon reading B2 to mean as defined above.

48. The requester explains that reference to a “sphericity of +/- 5µm” means that the sphericity of a polycrystalline diamond-coated ball produced by the method of B2 is within 5µm of the target sphericity, where the target sphericity is 0µm (i.e. perfectly spherical). The requester argues that reference to a “sphericity of +/- 5µm” does not mean that the surface of a single sample varies from -5µm to +5µm from an ideal sphere (which would be a 10µm variation). Rather, it means that the sphericity values for a plurality of samples are expected to be within the range -5µm to +5µm. It is argued it would make no sense to state a sphericity for a single sample as being “+/- 5µm”. I agree with the requester on this point of interpretation. The parameters are described as “shape tolerances” i.e. an expression of the range or spread of acceptable values (for a plurality of samples) that the parameter can take.

49. B2 discloses Examples 1-3 in which the external surface of the ball having the diamond coated layer has a tolerance for sphericity of +/- 4µm, +/- 5µm and +/- 3µm respectively. Claim 6 requires the segment of the convex surface to have a maximum peak to valley deviation from a perfect spherical surface of less than about 5 µm.

50. Each of the Examples 1-3 gives a tolerance for surface roughness <20nm Ra. Again using the relationship disclosed in the patent of Rq = 1.25Ra means B2 discloses the root mean square roughness Rq of <25nm. Claim 6 requires the root mean square roughness Rq to be less than about 30nm.

51. Therefore in my opinion claim 6 is also not novel in light of B2.

Further argument regarding claim 6

52. I note that the requester has also submitted substantial further argument that claim 6 is not inventive in light of B1, B2, B3 (when taken alone or in combination with any of B1, B2, B4 or common general knowledge (CGK)) and also A9 (when taken in combination with either A10 or A7). Having reached the opinion that claim 6 is not novel in light of either B1 or B2 I am not going to go on to provide detailed analysis of this further argument. Given that the Opinions service is intended to be a quick, simple and low-cost service, I do not believe it would be reasonable or practical for me to do so. The further argument put forward by the requester in my opinion is well reasoned and I find myself in agreement.

Dependent claims 7-14

53. Dependent claims 7-14 are as follows:

> *7. An element as claimed in claim 6, wherein the convex surface (10) further has a radius of curvature less than about 20 mm.*
>
> *8. An element as claimed in claim 6 or claim 7, wherein the element is a solid polycrystalline diamond.*
>
> *9. An element as claimed in any one of claims 6 to 8, further comprising another convex surface on an opposite side of the element to the convex surface (10).*
>
> *10. A tool tip for use in a metrology apparatus comprising a diamond element as claimed in any of claims 6 to 9.*
>
> *11. A reference sphere for use in measuring hole diameters comprising a diamond element as claimed in any of claims 6 to 9.*
>
> *12. A method of polishing a spherical surface (10) on a polycrystalline CVD diamond element or a diamond element comprising base material coated with CVD diamond, comprising:*
>
> > *rotating the element (2) about a first axis (12) at a first rate of rotation; pressing a cup (22) having a polishing surface against the spherical surface, the polishing cup (22) rotating about a second axis (21) at a second rate of rotation much higher than the first rate, wherein the spherical surface (10) is first formed using a method as claimed in claim 4 or claim 5.*
>
> *13. A method as claimed in claim 12, wherein the cup (22) additionally rotates about a third axis (25) at a third rate lower than the first rate, the third axis (25) being perpendicular to the first axis (12) and passing through the first axis (12) at the centre of curvature of the spherical surface (10), the rotation about the third axis (25) being an oscillatory motion describing less*

than a full circle.

14. A method as claimed in claim 12 or claim 13, wherein the polishing surface (10) comprises a layer of polycrystalline CVD diamond.

Construction of the dependent claims

54. I can see no issue with the construction of any of dependent claims 7-11 and 13-14. These dependent claims are clear and a person skilled in the art would have no difficulty in construing their scope. The requester has not filed any argument regarding the construction of these claims.

55. Claim 12 requires the element 2 to rotate at a first rate and the polishing cup 22 to rotate at a second rate, wherein the second rate is “much higher” than the first rate. The requester has argued that this is completely meaningless. Whilst I agree to some extent with the requester that the claim could be clearer I do not agree that this feature is meaningless. The claim has been worded intentionally to include the wording and provide a degree of limitation on the relative speeds of rotation of the element and the polishing cup. With reference to figure 3, paragraph [0079] of the patent describes the element 2 being brazed to rod 11 which is mounted in a rotational stage 20. The stage 20 is described as rotating at a low rate of typically 0.1-100rpm around axis 12 of the rod. Paragraph [0080] describes the polishing cup 22 being mounted on a high-speed rotary spindle 21 which rotates at a rate of the order of 5,000-60,000rpm. Examples II-1 given in the patent at paragraph [0142] describe rotation speeds falling within the given ranges i.e. 20rpm for the element and 20,000rpm for the polishing cup. This is a clear example of the polishing cup being rotated at a “much higher” rate than the element. In my opinion the skilled person would have difficulty understanding where the boundaries of a “much higher” relative rotation rate would lie but based on the examples given in the patent would construe the claim to require the second rotation rate to be at least 50 times higher than the first i.e. 5000:100.

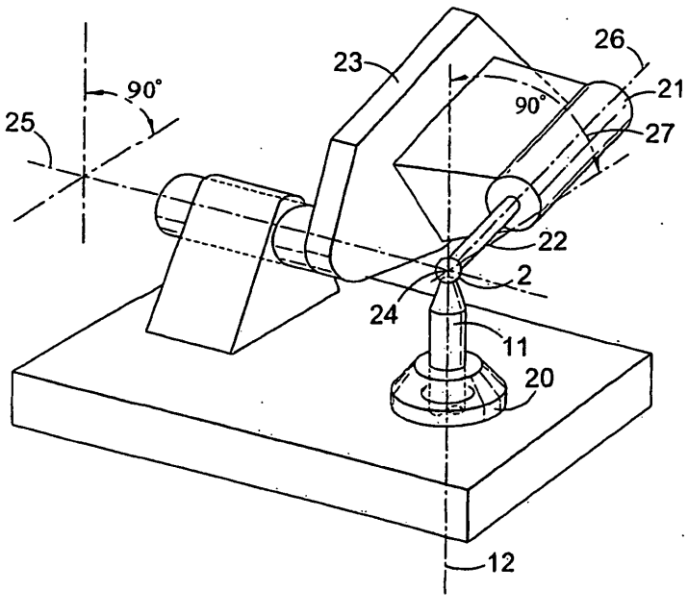


FIG. 3

Novelty and inventive step

56. B1 discloses a substrate sphere having a radius of approximately 18mm and a coating thickness of between 150-200 µm. B2 discloses substrate balls having diameters of 32mm, 28mm and 32mm respectively in Examples 1-3. B3 refers to using a substrate ball having a diameter of 2mm. Therefore all of B1-B3 disclose the features of claim 7.

57. The requester has argued that the choice of substrate material is entirely dependent on the application i.e. it's a routine design choice and therefore claim 8 is obvious in light of B1-B3. I agree.

58. Both B1 and B2 disclose a polycrystalline diamond coating having the required surface properties over a 270º segment of a sphere. Therefore both B1 and B2 disclose the features of claim 9.

59. The requester has submitted substantial argument regarding the obviousness of claim 10. The requester outlines how claim 10 is obvious in light of B1 (when taken alone or in combination with any of B4, B5, A1 or A2); B2 (when taken alone or in combination with any of B4, B5, A1 or A2); B4 (when taken in combination with either B1 or B2); any of B5, A1 or A2 when taken in combination with either of B1 or B2; B4 in light of CGK; and B5 in light of CGK. As discussed above the Opinions service is intended to be a quick, simple and low-cost service, I do not believe it would be reasonable or practical for me to provide detailed analysis of all the argument relating to claim 10.

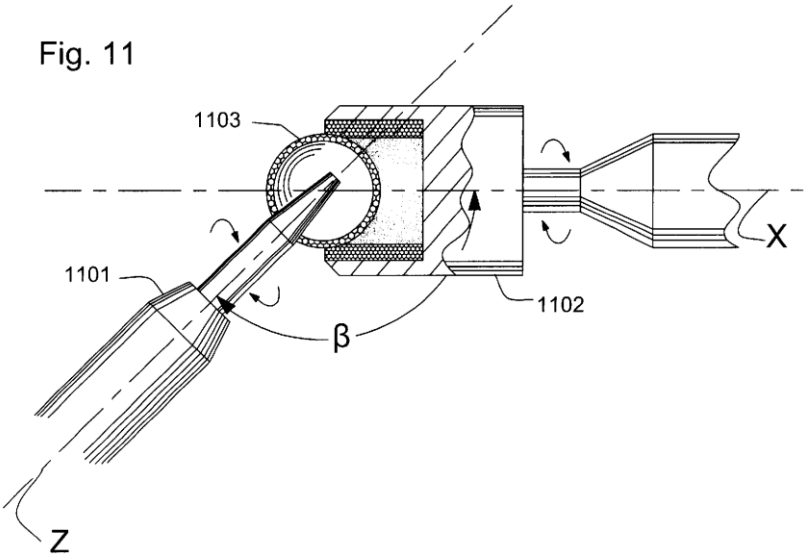
60. All of the argument put forward by the requester relating to claim 10 is well reasoned in my opinion but I would highlight the argument centred on B5, A1 and A2 which all disclose tool tips comprising polycrystalline diamond. I agree it would be obvious for a person skilled in the art to apply the polycrystalline diamond sphere of B1 to any of the tool tips in B5, A1 and A2. Therefore claim 10 is considered to be obvious.

61. Again the remaining argument relating to claim 10 is well reasoned and I agree therewith.

62. I agree with the requester's argument that it would be obvious to use the accurately spherical balls of B1 as a reference sphere. Therefore claim 11 is considered to be obvious in light of B1.

63. Claim 12 is dependent upon claim 4 which in turn is dependent upon any of claims 1-3. Claims 1-4 were considered to be not novel in light of A9 in my earlier opinion. The requester has argued that claim 12 is obvious in light of A9 when taken in combination with any of A10, A7 or B2. In figure 11 of A10 reproduced below, the requester argues that the part labelled 1103 is a spherical polycrystalline diamond element that requires finishing (grinding and polishing) similar at least externally to the type of spherical polycrystalline diamond element that would result from performing the method of claim 1 of the patent.

Fig. 11



64. A passage from A10 relating to figure 11 reads:

> *Referring to FIG. 11, it can be seen that a rotator 1101 holds a part to be finished 1103, in this case a convex sphere, by use of a spindle. The rotator 1101 is rotated continuously about its longitudinal axis (the z axis). A grinding or polishing wheel 1102 is provided is rotated continuously about its longitudinal axis (the x axis). The moving part 1103 is contacted with the moving grinding or polishing wheel 1102. The angular orientation [beta] of the rotator 1101 with respect to the grinding or polishing wheel 1102 may be adjusted and oscillated to effect grinding or polishing of the part (ball or socket) across its entire surface and to maintain sphericity.*

65. Whilst I agree with the applicant that A10 discloses a method very similar to that of claim 12, it is silent on the relative rotational speeds of the moving part 1103 and the polishing wheel 1101. As discussed above I do not agree with the requester that this feature is meaningless.

66. Similar arguments have been put forward by the requester for documents A7 and B2. Again I agree that these two documents both disclose methods similar to the method of claim 12 but again both documents are silent on the relative rotational speeds of their respective equivalent elements and polishing cups.

67. The requester has provided a four-step Windsurfing/Pozzoli analysis of claim 12 in which the requester has provided a definition of the skilled person and the common general knowledge of that person as being:

> *"The person skilled in the art is one familiar with techniques for the forming and shaping of polycrystalline diamond material."*

I would that the skilled person would be "one skilled in the fabrication and application of diamond materials having the knowledge of techniques for the forming and shaping of polycrystalline diamond material".

68. I have no issue with the definition of the inventive concept of claim 12 put forward by the requester as:

"Relates to providing additional smoothness and/or roundness to a spherical polycrystalline diamond element produced by the method of claim 4 or 5."

69. Where I differ from the requester in their analysis is in step 3. The requester has argued that the differences between the inventive concept and the disclosure of A9 lie in:

> *"Document A9 does not disclose a polishing method in which the element is rotated about one axis at the same time as a polishing cup is rotated about another axis."*

As explained above I consider the feature of the rotational speeds of the element and polishing cup to be of at least some significance. Therefore I consider the differences between the inventive concept and the disclosure of A9 to be:

> *"Document A9 does not disclose a polishing method in which the element is rotated about one axis at a first rate of rotation at the same time as a polishing cup is rotated about another axis at a second rate of rotation; wherein the second rate of rotation is "much higher" than the first."*

70. As a result I also therefore disagree with the requester's analysis in step 4 that it is obvious to apply the known methods of any of A10, A7 or B2 to document A9 to arrive at the invention of claim 12. As discussed above all of documents A10, A7 and B2 are silent on the rotational speeds of the elements and polishing cups therein. Therefore none of them disclose all of the differences between the inventive concept of claim 12 and A9 as I have defined above. In my opinion the skilled person on combining the teaching of A9 with any of A10, A7 or B2 would not arrive at the invention of claim 12. The further difference of the rotational speeds being significantly different as I have construed above in paragraph 55 distinguishes the invention of claim 12 from the prior art.

71. Therefore in my opinion claim 12 is novel and inventive.

72. By virtue of being dependent upon claim 12, claims 13 and 14 are also considered to be novel and inventive.

Sufficiency

73. The requester contends that the invention as set out in claims 6-11 is insufficiently described i.e. that it is not sufficiently demonstrated that the method described in the patent is actually capable of achieving the sphericity and surface roughness required by claim 6.

74. The requester explains that the patent includes Example II.1 which relates to "Fabrication of a CVD diamond coated spherical measurement styli" in accordance with the invention is almost identical to Example I.1 which relates to "Super-hemispherical synthetic CVD-grown single-crystal diamond SIL with 8-sided pavilions" which is stated in the patent as not covering the scope of the present invention. The requesters further explains that Example I.1 is the same as Example 1 of proprietor's earlier application A11.

75. In essence the requester is arguing that the similarities between Example I.1 and Example II.1 (being the same apart from a few minor differences) leads one to the conclusion that the Example I.1 relating to single-crystal diamond has been copy and pasted under a different title relating to polycrystalline diamond to give the appearance of a method that works to produce an element as required by claim 6.

76. I will now consider the three generally accepted aspects of sufficiency separately.

Classical insufficiency

77. Classical insufficiency arises where the express teaching of the patent does not enable the skilled addressee to perform the invention. This is what the requester is arguing with respect to claims 6-11 in that there is no enabling disclosure of a method that would produce the element of claim 6.

78. Turning to the description at paragraphs [0079] to [0080] the skilled person (who is the same as the skilled person defined above in relation to inventive step) is taught to improve the characteristics of the diamond element using a polishing apparatus as shown in figure 3 with the element 2 being rotated at a low rate of 0.1-100rpm and the polishing cup 22 being rotated at a high rate of 5,000-60,000rpm. Paragraph [0084] explains that use of the apparatus within the stated parameters would produce an element having a surface having a root mean square roughness, Rq, of less than about 30 nm and surface deviations equal to or less than 5µm. Paragraph [0087] further explains the element would have an RMS deviation of the spherical segment, as measured by averaging over the square of deviations over the spherical segment, of less than or equal to about 500 nm.

79. As explained by the requester the patent includes an example, Example II.1, which describes the element 2 being rotated at 20rpm and the polishing cup 22 being rotated at 20,000rpm. These parameters fall within the parameter ranges given above. The polished element is said to have deviations from an ideal spherical surface smaller than 2µm and a surface roughness, Rq, significantly less than 10nm. Further the RMS deviation following further polishing was measured as 5.6nm, 7.3nm and 5.4nm for three separate samples.

80. Whilst I am sympathetic to the requester's arguments, the specification does provide the skilled person with a range of parameters for use of the apparatus of figure 3 to produce the element of claim 6. There is provided a specific example, Example II.2, which is describes the apparatus used within those parameters providing an element falling within the scope of claim 6. Therefore I do not consider claims 6-11 to be classically insufficient.

Insufficiency by ambiguity

81. As discussed above under claim construction in my opinion claims 6-11 are clear and straightforward and a person skilled in the art would have no difficulty in construing the scope of the claims. I am content that claims 6-11 are not insufficient by ambiguity.

Insufficiency by excessive claim breadth

82. Claim 6 has a number of alternatives i.e. the diamond element is polycrystalline, the

element having at least one of the properties (a) or (b); or the diamond element comprises a base material which is coated with diamond, the element having at least one of the properties (a) or (b). The specification discloses as described above in paragraphs 77 and 78 the invention sufficient to enable the invention to be performed to the full extent of the monopoly claimed in claim 6. I am content that claims 6-11 are not insufficient by excessive claim breadth.

Conclusion

83. I consider that the invention as defined by independent claim 6 to be anticipated by at least B1 and B2 and dependent claims 7-11 to lack novelty and/or inventiveness as outlined above.

84. I consider claims 12-14 to be novel and inventive in light of the evidence before me.

85. I consider the specification to disclose the invention of claims 6-11 clearly and completely enough for it to be performed by a person skilled in the art.

Application for review

86. Under section 74B and rule 98, the proprietor may, within three months of the date of issue of this opinion, apply to the comptroller for a review of the opinion.

Marc Collins
Examiner

NOTE

This opinion is not based on the outcome of fully litigated proceedings. Rather, it is based on whatever material the persons requesting the opinion and filing observations have chosen to put before the Office.