

PATENT COOPERATION TREATY

From the:
INTERNATIONAL SEARCHING AUTHORITY

To:

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PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing (*day/month/year*)
19 September 2018

Applicant's or agent's file reference
1123911

FOR FURTHER ACTION
See paragraph 2 below

International application No.
PCT/AU2018/050840

International filing date (*day/month/year*)
09 August 2018

Priority date (*day/month/year*)
09 August 2017

International Patent Classification (IPC) or both national classification and IPC
B01J 20/34 (2006.01) A61M 16/22 (2006.01) B01J 20/22 (2006.01) B01J 20/28 (2006.01) B01D 53/62 (2006.01) B01D 53/04 (2006.01)

Applicant
COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION

1. This opinion contains indications relating to the following items:

- Box No. I Basis of the opinion
- Box No. II Priority
- Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- Box No. IV Lack of unity of invention
- Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- Box No. VI Certain documents cited
- Box No. VII Certain defects in the international application
- Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA
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Date of completion of this opinion
19 September 2018

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WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.

PCT/AU2018/050840

Box No. I **Basis of this opinion**

1. With regard to the **language**, this opinion has been established on the basis of:
 - The international application in the language in which it was filed
 - A translation of the international application into, , which is the language of a translation furnished for the purposes of international search (under Rules 12.3(a) and 23.1(b)).
2. This opinion has been established taking into account **the rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(a))
3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing:
 - a. forming part of the international application as filed:
 - in the form of an Annex C/ST.25 text file.
 - on paper or in the form of an image file.
 - b. furnished together with the international application under PCT Rule 13ter.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.
 - c. furnished subsequent to the international filing date for the purposes of international search only:
 - in the form of an Annex C/ST.25 text file (Rule 13ter.1(a)).
 - on paper or in the form of an image file (Rule 13ter.1(b) and Administrative Instructions, Section 713).
4. In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
5. Additional comments:

**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International Application No.

PCT/AU2018/050840

Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims 1 - 36	YES
	Claims None	NO
Inventive step (IS)	Claims 1 - 24	YES
	Claims 25 - 36	NO
Industrial applicability (IA)	Claims 1 - 36	YES
	Claims None	NO

2. CITATIONS AND EXPLANATIONS:

CITATIONS

D1: US 2009/0032023 A1 (PASTRE et al.) 05 February 2009

D2: US 2017/0137450 A1 (KING ABDULLAH UNIVERSITY OF SCIENCE AND TECHNOLOGY [SA]) 18 May 2017

D3: WO 2016/036814 A1 (KING ABDULLAH UNIVERSITY OF SCIENCE AND TECHNOLOGY [SA]) 10 March 2016

D4: US 2017/0144099 A1 (MOHAMED EDDAOUDI et al.) 25 May 2017

D5: Sameh K. Elsaidi et al., Chem. Commun., 2015, 51, pages 15530 - 15533

NOVELTY (N)

D1 is considered to represent the closest prior-art, that discloses a reversible breathing apparatus and a method for removing carbon dioxide from breathing air in closed or partially closed systems comprising contacting the breathing air with a porous metal-organic framework material (MOF), wherein the closed or partially closed system comprises at least one breathing apparatus and also a breathing mask, a breathing suit or other life support systems (claim 1 and paragraph [0017]). D1 also discloses using the MOF in the breathing apparatus such as a breathing mask, removal of CO₂ from respiration air and reuse the air (paragraph [0006]). D1 further discloses that a mixture of MOF and a solvent is used to form shaped bodies by heating; extruded products, pellets, disks, rods, and hollow bodies etc., packed in a bed of filter type container (paragraphs [0022] and [0071] and claims 5 – 6). It appears that the MOF used is activated during the preparation by heating at elevated pressure (paragraph [0080]). The shaped bodies are packed in breathing apparatus to filter gases and therefore it is considered that these adsorbent bodies have at least one dimension greater than 0.5 mm.

However, D1 fails to disclose that the said shaped bodies MOF are of SIFSIX-3-Ni and also forming 3-dimensional crystal structure in the shaped bodies during heating to at most 1600C at a reduced pressure less than 500 mbar. Therefore claim 1 is novel and complies with PCT Article 33(2).

The appended claims 2-24 define further features to those defined in claim 1. Therefore, claims 2-24 are also novel and complies with PCT Article 33(2).

With respect to claim 25, D1 fails to disclose that the said shaped bodies of MOF is of SIFSIX-3-Ni having at least 60% of 3-dimensional crystal structure and the rest being 2 dimensional structure. Therefore claim 25 is novel and complies with PCT Article 33(2).

The appended claims 26 - 36 define further features to those defined in claim 25. Therefore, the subject matter of claims 26 - 36 is also novel and complies with PCT Article 33(2).

INVENTIVE STEP (IS)

Claim 1: None of the above prior art documents either individually or in combination obviously suggests to a person skilled in the art, a rebreather apparatus and a method of forming absorbent bodies with SIFSIX-3-Ni by heating a paste of SIFSIX-3-Ni and a solvent formed in to shaped bodies, heating to a temperature of at most 160⁰C at reduced pressure of less than 500 m bar., thus forming 3-dimensional SIFSIX-3-Ni crystal structure in the shaped body, as currently defined. The claimed invention is not obvious in the light of any of the cited documents nor is it disclosed in any obvious combination of them. It is also considered that it would

not be obvious to a person skilled in the art in the light of common general knowledge either by itself or in combination with any of these documents. Therefore, claim 1 involves an inventive step and complies with PCT Article 33(3).

Claims 2 - 24 embody further aspects of the inventive concept and comply with PCT Article 33(3).

Claims 25 and 27: The invention defined in claims 25 and 27 does not involve an inventive step when the disclosures of D1 and D2 are combined.

D1 discloses a breathing apparatus and a method for removing carbon dioxide and optionally water from breathing air in closed or partially closed systems comprising contacting the breathing air with a porous metal-organic framework material (MOF), wherein the closed or partially closed system comprises at least one breathing apparatus and also a breathing mask, a breathing suit or other life support systems (claim 1 and paragraph [0017]). D1 also discloses using the MOF in a breathing apparatus such as a breathing mask, removal of CO₂ from respiration air and reuse the air (paragraph [0006]). D1 further discloses that MOF is used in the form of moulded products; such as pellets, disks, rods, and hollow bodies etc., packed in a bed of filter type container (paragraphs [0022] and [0071] and claims 5 – 6. The said shaped bodies are packed in the breathing apparatus to filter gases and therefore it is considered that these adsorbent bodies have at least one dimension greater than 0.5 mm.

The claimed invention differs from D1 in that the adsorbent bodies comprises SiFsix-3-Ni having at least 60% 3-dimensional SIFSIX-3-Ni crystal structure, the balance being 2 dimensional SIFSIX-3-Ni structure.

D2 discloses ((Fig. 2B; paragraphs [0029], [0038] and [0039]) that a metal organic framework namely SIFSIX-Ni-3 is used industrial applications, pertaining to CO₂ adsorption, the CO₂ uptake during adsorption shows an increase in the CO₂ uptake with increasing the activation temperature, and optimal CO₂ adsorption isotherm is obtained after activation at 105⁰C. D2 further discloses that during the preparation of a SIFSIX-3-Ni structure from a mixture of SIFSIX-3-Ni powder and a solvent, the 2D crystalline structure is changed to 3D crystalline structure. D2 also discloses that transformation of 2D structure to the 3D structure is temperature dependent process and completes at about 70⁰C, however heated to 130⁰C for more stability of the structure.

It would be obvious to combine the teachings of citations D1 with D2 as they are all directed to removing CO₂ gas using MOFs. This obvious combination discloses all the features of claims 25 and 27, when the shaped bodies of MOF in D1 are replaced with SIFSIX-3-Ni having 3 dimensional crystal structure.

Claims 26, 28 – 31, 33: Furthermore, it is considered that the features added by appended claims 26, 28 - 31 and 33 which deal with uptake of CO₂ in the gas stream in the apparatus, storing the absorbent in an inert gas prior to use, absorbent shaped bodies forming a packed bed between membranes that fits in to a removal inner container within a housing and said shaped bodies comprises elongate bodies with circular or polygonal cross-sections, relate to arrangements that are merely matters of design choice when the general technical knowledge about the state of the art is used and therefore cannot contribute to providing a patentable inventive step with respect to the combined disclosure of D1 and D2. In this regard, D1 further discloses, that shaped bodies may be rod shaped extrudates (paragraph [0071], shaped bodies are packed into a bed (paragraph [0070]) and uptake capacity of CO₂ is exemplified (example). D2 also discloses the sorption behaviour of CO₂ in SIFSIX-3-Ni adsorbents (paragraph [0039]). Therefore, claims 26, 28 – 31 and 33 do not involve an inventive step and do not comply with PCT Article 33(3).

Claims 32, 34 – 36: Furthermore, it is considered that the features added by appended claims 32 and 34 – 36 which deal with, liquid free gas flow arrangement through the packed bed to facilitate adsorption of carbon dioxide from exhaled breathing gas, regenerating the adsorbent bodies and using the said adsorbent in a breathing mask or other life supporting system, relate to arrangements that are merely matters of design choice when the general technical knowledge about the state of the art is used and therefore cannot contribute to providing a patentable inventive step with respect to the combined disclosure of D1 and D2. In this regard, D1 further discloses applications of the breathing apparatus in a breathing mask, a breathing suit, or other life support systems (paragraph [0019]), comprising facilities for such as a mouthpiece for a respiratory mask (paragraphs [0020] to [0025]) and regeneration of the adsorbent material possibly with heat (paragraphs [0030] to [0035]). Therefore, claims 32 and 34 - 36 do not involve an inventive step and do not comply with PCT Article 33(3).

INDUSTRIAL APPLICABILITY (IA)

The invention defined in the claims 1 – 36 is considered to meet the requirements of Industrial Applicability under Article 33(4) of the PCT because it can be made by, or used in, industry.