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Some comments on: Yonoff et al. 'Research trends in proton exchange membrane fuel cells during 2008–2018: A bibliometric analysis', *Heliyon*, 2019, 5: e01724

Yonoff et al. recently published a paper in the journal, entitled 'Research trends in proton exchange membrane fuel cells during 2008–2018: A bibliometric analysis' [1]. The results in the original paper [1] were unacceptable because the use of method was inappropriate. Yonoff et al. stated in section 2. Materials and methods that 'Data were analyzed between 2008 to 2018; it was extracted from the SCI-Expanded online version of Thomson Reuters Web of Science, where the filter by title was used for the search keywords proton exchange membrane fuel cells.'

'SCI-Expanded online version of Thomson Reuters Web of Science' no longer exists and has been replaced by the Science Citation Index Expanded (SCI-EXPANDED) online version of Clarivate Analytics Web of Science.

The Clarivate Analytics Web of Science Core Collection, the online version of the Science Citation Index Expanded (SCI-EXPANDED), will provide the readers a clearer understanding of which database the authors have used in their research. Based on the searching keywords used in the original paper [1], all related keywords in SCI-EXPANDED were considered. The database was searched using the searching strategy ("proton exchange membrane fuel cells" or "proton exchange membrane fuel cell" or "PEMFCs" or "PEMFC" or "proton membrane exchange fuel cells" or "PEM fuel cells" or "PEM fuel cell" or "proton exchange fuel cell" or "proton exchange fuel cells" or "protonexchange membrane fuel cell" or "proton exchanged membrane fuel cells" or "proton exchange memberane fuel cells" or "proton exchange membrane (PEM) fuel cell" or "proton exchange membrane (PEM) fuel cells") not ("polymer electrolyte membrane fuel cells" or "polymer electrolyte membrane fuel cell" or "polymer exchange membrane fuel cells" or "polyelectrolyte membrane fuel cell" or "polymeric electrolyte membrane fuel cell" or "proton electrolyte membrane fuel cell" or "polymer electrolyte membrane (PEM) fuel cells" or "polymer electrolyte membrane (PEM) fuel cell") in terms of topic (title, abstract, author keywords, and *KeyWords Plus*) in SCI-EXPANDED within the publication years from 2008 to 2018. This resulted in 9,504 documents. This data was collected on 11 May in 2020.

However, the SCI-EXPANDED is not designed for bibliometric studies but for researchers to find published literatures [2, 3]. *KeyWords Plus* collects repetitive terms within the references that the author(s) cited [4]. In another word, it gives a greater insight in the publications, allowing researchers to read an expansive collection of studies [4]. Therefore, documents searched out by *KeyWords Plus*, may be irrelevant to the bibliometric study topic because it may only appear in the references instead of the paper instead [5]. Documents that were only searched out by *KeyWords Plus* can be references in the PEMFCs. However these documents are not researches about the PEMFCs. In order to prevent problems like this, a filter named 'front page' (including the document title, the abstract, and the author keywords) was proposed by Ho's group [6, 7, 8]. Consequently, documents with searching keywords

Table 1. Shows distribution of publications for PEMFC by document types from 2008 to 2018.

Document type	*TP*	%	TC_{2018}	CPP_{2018}
Article	7,694	94	141,744	18
Proceedings paper	733	9.0	12,698	17
Review	288	3.5	22,031	76
Meeting abstract	128	1.6	16	0.13
Correction	47	0.57	17	0.36
Editorial material	21	0.26	57	2.7
Book chapter	6	0.073	212	35
News item	2	0.024	0	0
Retraction	2	0.024	0	0
Letter	1	0.012	37	37
Reprint	1	0.012	1	1.0

TP: number of articles; TC_{2018}: total citations from Web of Science Core Collection since publication to the end of 2018; CPP_{2018}: citations per paper (TC_{2018}/*TP*).

Table 2. Characteristics of PEMFC scientific article between 2008 and 2018.

Year	*TP*	*AU*	*AU/TP*	*NR*	*NR/TP*
2008	550	2,256	4.1	14,342	26
2009	564	2,376	4.2	15,993	28
2010	799	3,491	4.4	24,171	30
2011	761	3,307	4.3	23,967	31
2012	768	3,350	4.4	24,805	32
2013	670	3,050	4.6	22,408	33
2014	772	3,522	4.6	27,366	35
2015	692	3,205	4.6	25,962	38
2016	722	3,385	4.7	28,684	40
2017	697	3,458	5.0	28,567	41
2018	699	3,488	5.0	29,971	43
Average			4.5		35
Total	7,694	34,888		266,236	

TP: total number of articles; *AU*: number of authors; *AU/TP*: number of authors per article; *NR*: number of cited references; *NR/TP*: number of cited references per article.

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Table 3. Top 10 journals in PEMFC during the period 2008–2018.

Rank	Journal	*TP*	%
1	International Journal of Hydrogen Energy	1,637	21
2	Journal of Power Sources	1,037	13
3	Journal of the Electrochemical Society	365	4.7
4	Electrochimica Acta	341	4.4
5	Fuel Cells	249	3.2
6	Journal of Fuel Cell Science and Technology	158	2.1
7	Journal of Membrane Science	148	1.9
8	Applied Energy	139	1.8
9	Energy	139	1.8
10	Energy Conversion and Management	110	1.4

TP: total number of articles.

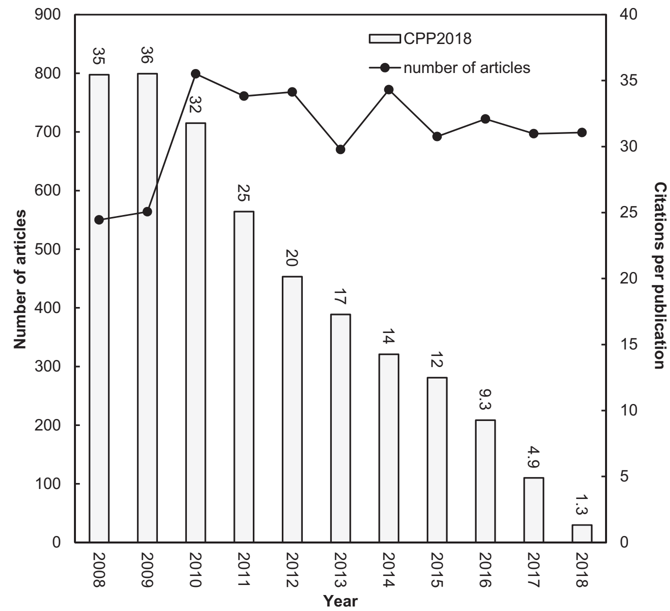

Figure 1. Number of articles and Citations per publication (CPP_{2018}).

in their ‘front page’ were considered to be relevant publications. As a result, 8,184 documents (86% of the 9,504 documents) had searching keywords in their ‘front page’ while 1,320 documents (14%) did not have any searching keywords in their ‘front page’. In all, 8,184 documents related to proton exchange membrane fuel cells were found. Table 1 shows distribution of publications for PEMFC by document types from 2008 to 2018. Documents could be classified in two document types in the Web of Science Core Collection, for example, highly cited documents ‘Review of the proton exchange membranes for fuel cell applications’ [9] was characterized as both article and proceedings paper; and ‘Advances in the development of inorganic-organic membranes for fuel cell applications’ [10] was characterized as both review and book chapter. Thus, the sum of percentages is higher than 100%. In 2011, Ho's group proposed a citation indicator, TC_{year}, the total number of citations from Web of Science Core Collection since publication to the end of the most recent year [11, 12]. The advantage of TC_{year} is that they are invariable and that they can ensure repeatability in comparison to the index of citation from the Web of Science [6]. Using the same idea, citation indicator, CPP_{2018}, the citations per publication was also applied in Table 1. Other related results were also presented in tables. The characteristics of annual articles and the top 10 productive journals on PEMFC in the SCI-EXPANDED from 2008 to 2018 were shown in Tables 2 and 3 respectively.

Yonoff et al. mentioned in section 3.7. Article visibility and citation trends that ‘To assess the visibility of research articles, the number of times an item was cited from publication to the end of 2018 (TC2018) was used as an indicator [28].’ This is a quotation error. “TC2018” was not mentioned in the cited reference [13]. In 2011, the citation indicator (TC_{year}) was first proposed by Ho's group [11, 12].

Yonoff et al. also noticed that ‘The scientific impact was studied by analyzing the 20 most cited publications in PEMFC research for papers published from 2008 to 2018. The list of the most cited articles (TC2018 > 300) is shown in Table 4.’ ‘Article title’ in Table 4 such as ‘Fuel Cell Systems Explained’ and ‘PEM Fuel Cells’ from the original paper [1] cannot be found in SCI-EXPANDED. Only five (25% of the 20 articles) were ‘article’ and 13 were ‘review’. Only two of the 20 articles in Table 4 of the original paper [1] such as ‘Effective diffusivity and water-saturation distribution in single- and two-layer PEMFC diffusion medium’ [14] and ‘Visualization of water buildup in the cathode of a transparent PEM fuel cell’ [15] were related to proton exchange membrane fuel cells. Therefore, most of the articles used in the original paper were irrelevant to ‘proton exchange membrane fuel cells’.

Table 4. Top 16 articles with TC_{2018} > 300.

Rank (TC_{2018})	Article title	Reference
1 (2,030)	Pd–Pt bimetallic nanodendrites with high activity for oxygen reduction	[16]
2 (886)	Recent advances in non-precious metal catalysis for oxygen-reduction reaction in polymer electrolyte fuel cells	[17]
3 (774)	Review of the proton exchange membranes for fuel cell applications	[9]
4 (725)	Electrocatalytically active graphene-platinum nanocomposites. Role of 2-D carbon support in PEM fuel cells	[18]
5 (579)	Hydrogen oxidation and evolution reaction kinetics on platinum: Acid vs alkaline electrolytes	[19]
6 (504)	Synthesis and oxygen reduction activity of shape-controlled Pt_3Ni nanopolyhedra	[20]
7 (485)	Interface-confined ferrous centers for catalytic oxidation	[21]
8 (360)	Nitrogen doped graphene nanoplatelets as catalyst support for oxygen reduction reaction in proton exchange membrane fuel cell	[22]
9 (343)	High performance Fe- and N- doped carbon catalyst with graphene structure for oxygen reduction	[23]
10 (326)	Structure-morphology-property relationships of non-perfluorinated proton-conducting membranes	[24]
11 (322)	New insights into the electrochemical hydrogen oxidation and evolution reaction mechanism	[25]
12 (320)	Experimental methods for quantifying the activity of platinum electrocatalysts for the oxygen reduction reaction	[26]
13 (316)	Low-temperature aqueous-phase methanol dehydrogenation to hydrogen and carbon dioxide	[27]
13 (316)	High-performance alkaline polymer electrolyte for fuel cell applications	[28]
15 (315)	Multimetallic Au/$FePt_3$ nanoparticles as highly durable electrocatalyst	[29]
16 (308)	A highly durable platinum nanocatalyst for proton exchange membrane fuel cells: Multiarmed starlike nanowire single crystal	[30]

TC_{2018}: Total number of citations from Web of Science Core Collection since publication to the end of 2018.

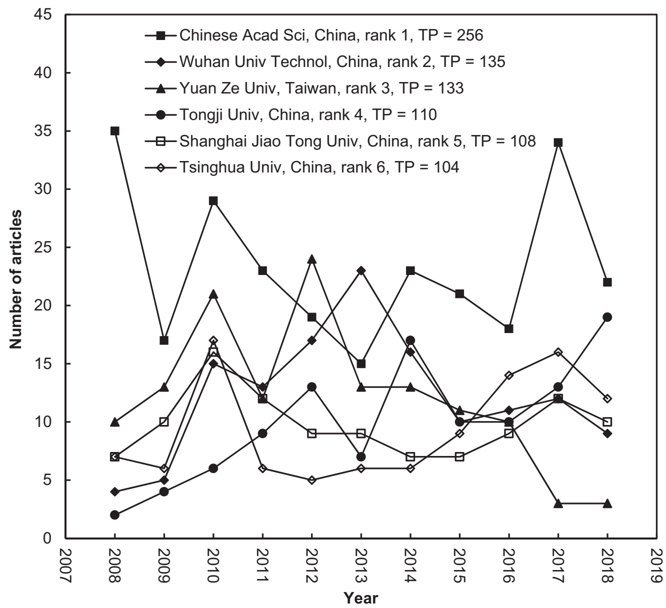

Figure 2. Top six institutes with $TP > 100$.

From the 7,694 articles in the result, the top 16 articles that were related to proton exchange membrane fuel cells with $TC_{2018} > 300$ were

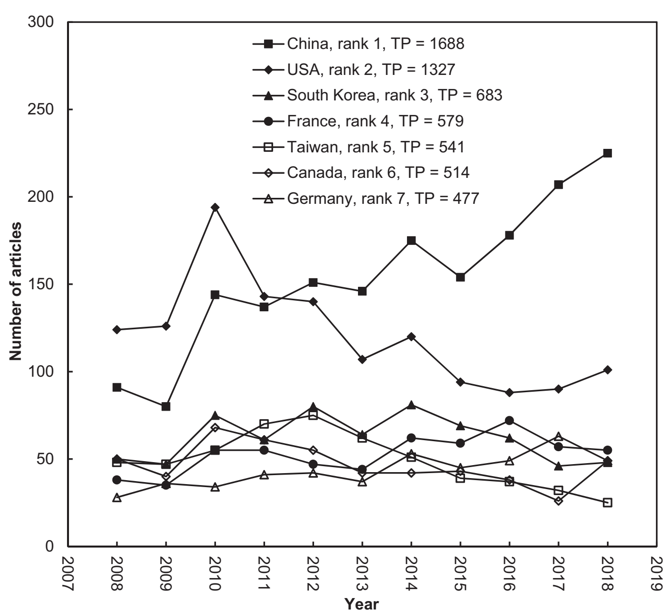

Figure 3. Top seven countries with $TP > 400$.

listed in Table 4. Furthermore, related results were also show in Figures 1, 2, 3, and 4.

Yonoff et al. published a bibliometric article in *Heliyon* using inappropriate methods. Therefore, results and discussion can be misleading to journal readers. In addition, citing the original paper does not only respect authors who have presented such novel idea in their research studies, but also allows the readers to read the original idea in detail [31]. In my opinion, Yonoff et al. should have cited the original paper for what they mentioned in their paper and used accurate methods, thereby providing acceptable results and discussion in their paper.

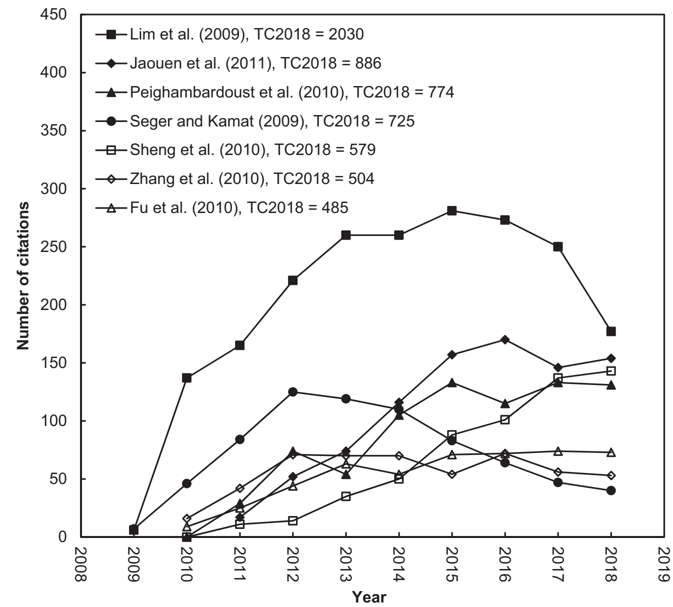

Figure 4. Top seven articles with $TC_{2018} > 400$.

Declarations

Author contribution statement

All authors listed have significantly contributed to the development and the writing of this article.

References

[1] R.E. Yonoff, G.V. Ochoa, Y. Cardenas-Escorcia, J.I. Silva-Ortega, L. Meriño-Stand, Research trends in proton exchange membrane fuel cells during 2008–2018: a bibliometric analysis, Heliyon 5 (5) (2019) e01724.

[2] Y.S. Ho, Comments on "Mapping the scientific research on non-point source pollution: a bibliometric analysis" by Yang et al. (2017), Environ. Sci. Pollut. Control Ser. 25 (30) (2018) 30737–30738.

[3] Y. Qi, X.Y. Chen, Z. Hu, C.F. Song, Y.L. Cui, Bibliometric analysis of algal-bacterial symbiosis in wastewater treatment, Int. J. Environ. Res. Publ. Health 16 (6) (2019). Article Number: 1077.

[4] E. Garfield, *KeyWords Plus*: ISI's breakthrough retrieval method. Part 1. Expanding your searching power on *Current Contents on Diskette*, Current Contents 32 (1990) 5–9.

[5] H.Z. Fu, Y.S. Ho, Top cited articles in thermodynamic research, J. Eng. Thermophys. 24 (1) (2015) 68–85.

[6] H.Z. Fu, M.H. Wang, Y.S. Ho, The most frequently cited adsorption research articles in the Science Citation Index (Expanded), J. Colloid Interface Sci. 379 (1) (2012) 148–156.

[7] H.Z. Fu, Y.S. Ho, Top cited articles in adsorption research using Y-index, Res. Eval. 23 (1) (2014) 12–20.

[8] Y.S. Ho, H.Z. Fu, Mapping of metal-organic frameworks publications: a bibliometric analysis, Inorg. Chem. Commun. 73 (2016) 174–182.

[9] S.J. Peighambardoust, S. Rowshanzamir, M. Amjadi, Review of the proton exchange membranes for fuel cell applications, Int. J. Hydrogen Energy 35 (17) (2010) 9349–9384.

[10] D.J. Jones, J. Roziere, Advances in the development of inorganic-organic membranes for fuel cell applications, Fuel Cell. I 215 (2008) 219–264.

[11] M.H. Wang, H.Z. Fu, Y.S. Ho, Comparison of universities' scientific performance using bibliometric indicators, Malays. J. Libr. Inf. Sci. 16 (2) (2011) 1–19.

[12] K.Y. Chuang, M.H. Wang, Y.S. Ho, High-impact papers presented in the subject category of water resources in the Essential Science Indicators database of the Institute for Scientific Information, Scientometrics 87 (3) (2011) 551–562.

[13] L.F. Caicedo Salinas, G.V. Ochoa, Y.C. Escorcia, A scientometric analysis of the investigation of biomass gasification environmental impacts from 2001 to 2017, Int. J. Energy Econ. Pol. 8 (5) (2018) 223–229.

[14] J.H. Nam, M. Kaviany, Effective diffusivity and water-saturation distribution in single- and two-layer PEMFC diffusion medium, Int. J. Heat Mass Tran. 46 (24) (2003) 4595–4611.

[15] K. Tüber, D. Pócza, C. Hebling, Visualization of water buildup in the cathode of a transparent PEM fuel cell, J. Power Sources 124 (2) (2003) 403–414.

[16] B. Lim, M.J. Jiang, P.H.C. Camargo, E.C. Cho, J. Tao, X.M. Lu, Y.M. Zhu, Y.N. Xia, Pd-Pt bimetallic nanodendrites with high activity for oxygen reduction, Science 324 (5932) (2009) 1302–1305.

[17] F. Jaouen, E. Proietti, M. Lefevre, R. Chenitz, J.P. Dodelet, G. Wu, H.T. Chung, C.M. Johnston, P. Zelenay, Recent advances in non-precious metal catalysis for oxygen-reduction reaction in polymer electrolyte fuel cells, Energy Environ. Sci. 4 (1) (2011) 114–130.

[18] B. Seger, P.V. Kamat, Electrocatalytically active graphene-platinum nanocomposites. Role of 2-D carbon support in PEM fuel cells, J. Phys. Chem. C 113 (19) (2009) 7990–7995.

[19] W.C. Sheng, H.A. Gasteiger, Y. Shao-Horn, Hydrogen oxidation and evolution reaction kinetics on platinum: acid vs alkaline electrolytes, J. Electrochem. Soc. 157 (11) (2010) B1529–B1536.

[20] J. Zhang, H.Z. Yang, J.Y. Fang, S.Z. Zou, Synthesis and oxygen reduction activity of shape-controlled Pt_3Ni nanopolyhedra, Nano Lett. 10 (2) (2010) 638–644.

[21] Q. Fu, W.X. Li, Y.X. Yao, H.Y. Liu, H.Y. Su, D. Ma, X.K. Gu, L.M. Chen, Z. Wang, H. Zhang, B. Wang, X.H. Bao, Interface-confined ferrous centers for catalytic oxidation, Science 328 (5982) (2010) 1141–1144.

[22] R.I. Jafri, N. Rajalakshmi, S. Ramaprabhu, Nitrogen doped graphene nanoplatelets as catalyst support for oxygen reduction reaction in proton exchange membrane fuel cell, J. Mater. Chem. 20 (34) (2010) 7114–7117.

[23] H.L. Peng, Z.Y. Mo, S.J. Liao, H.G. Liang, L.J. Yang, F. Luo, H.Y. Song, Y.L. Zhong, B.Q. Zhang, High performance Fe- and N- doped carbon catalyst with graphene structure for oxygen reduction, Sci. Rep. 3 (2013). Article Number: 1765.

[24] T.J. Peckham, S. Holdcroft, Structure-morphology-property relationships of nonperfluorinated proton-conducting membranes, Adv. Mater. 22 (42) (2010) 4667–4690.

[25] Y. Garsany, O.A. Baturina, K.E. Swider-Lyons, S.S. Kocha, Experimental methods for quantifying the activity of platinum electrocatalysts for the oxygen reduction reaction, Anal. Chem. 82 (15) (2010) 6321–6328.

[26] J. Durst, A. Siebel, C. Simon, F. Hasche, J. Herranz, H.A. Gasteiger, New insights into the electrochemical hydrogen oxidation and evolution reaction mechanism, Energy Environ. Sci. 7 (7) (2014) 2255–2260.

[27] M. Nielsen, E. Alberico, W. Baumann, H.J. Drexler, H. Junge, S. Gladiali, M. Beller, Low-temperature aqueous-phase methanol dehydrogenation to hydrogen and carbon dioxide, Nature 495 (7435) (2013) 85–89.

[28] J. Pan, S.F. Lu, Y. Li, A.B. Huang, L. Zhuang, J.T. Lu, High-performance alkaline polymer electrolyte for fuel cell applications, Adv. Funct. Mater. 20 (2) (2010) 312–319.

[29] C. Wang, D. van der Vliet, K.L. More, N.J. Zaluzec, S. Peng, S.H. Sun, H. Daimon, G.F. Wang, J. Greeley, J. Pearson, A.P. Paulikas, G. Karapetrov, D. Strmcnik, N.M. Markovic, V.R. Stamenkovic, Multimetallic Au/$FePt_3$ nanoparticles as highly durable electrocatalyst, Nano Lett. 11 (3) (2011) 919–926.

[30] S.H. Sun, G.X. Zhang, D.S. Geng, Y.G. Chen, R.Y. Li, M. Cai, X.L. Sun, A highly durable platinum nanocatalyst for proton exchange membrane fuel cells: multi-armed starlike nanowire single crystal, Angew. Chem. Int. Ed. 50 (2) (2011) 422–426.

[31] Y.S. Ho, Comments on "Adsorption characteristics and behaviors of graphene oxide for Zn(II) removal from aqueous solution", Appl. Surf. Sci. 301 (2014) 584.

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