

patents

2018

Perovskite photovoltaics: A review of the patent landscape

Published: 2018-Q2

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1: technical and commercial review of perovskite photovoltaics

2: overview of the patent landscape

3: review of top twenty commercial assignees patent portfolio

4: review of top twenty academic assignees patent portfolio

5: review of top twenty remaining assignees

6: content analysis

7: citation analysis

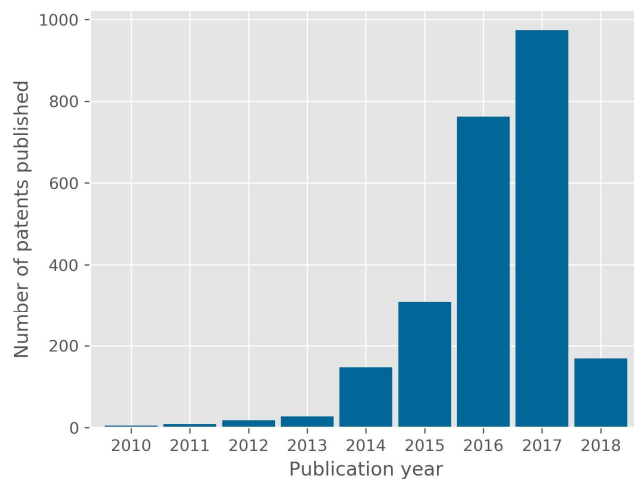
8: Appendix

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Since 2010 there has been 2420 perovskite photovoltaic patents published, 75% published within the past two years, with about 50% of the patents published in China, - so far 415 patents have granted

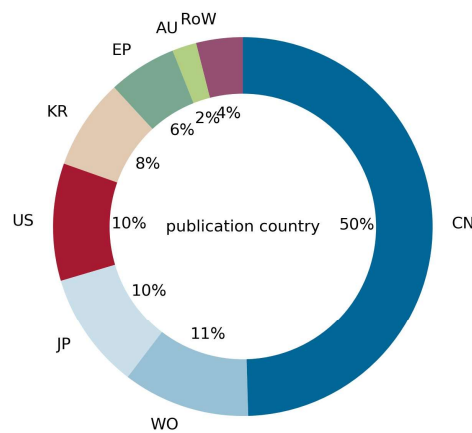
2420 patents have been filed since 2010

Includes published patents up to December 2017



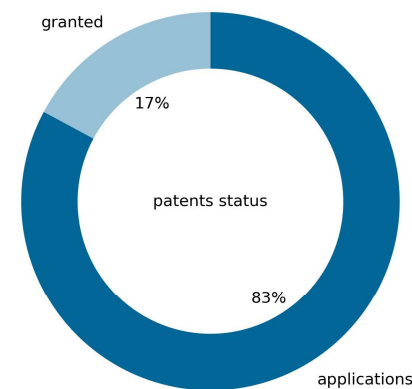
Worldwide patent filings – CN publications dominate

Largely Chinese Universities filing single patents



With 415 patents granted worldwide

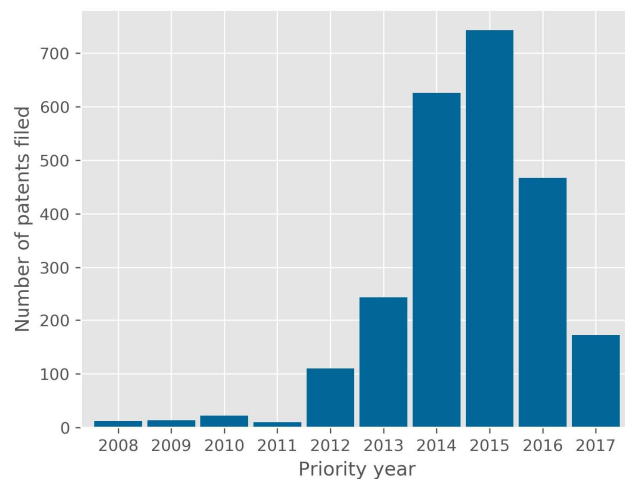
Top countries - CN:201, KR:79, JP:56, US:42, GB:15, TW:12



These patents arise due to inventions developed since 2012, largely by organisations in China, Japan, United States, Korean and Great Britain who are actively developing perovskite technologies

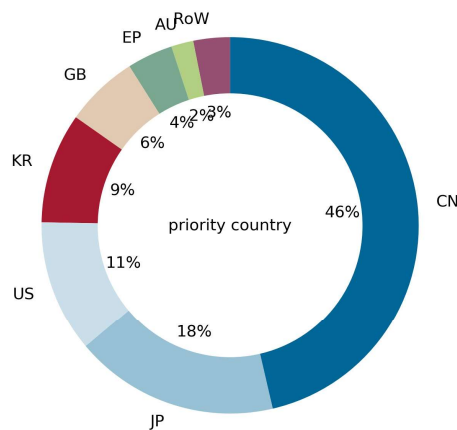
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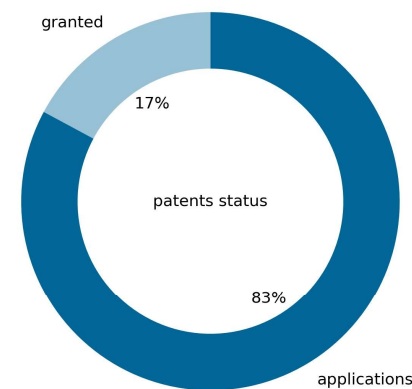
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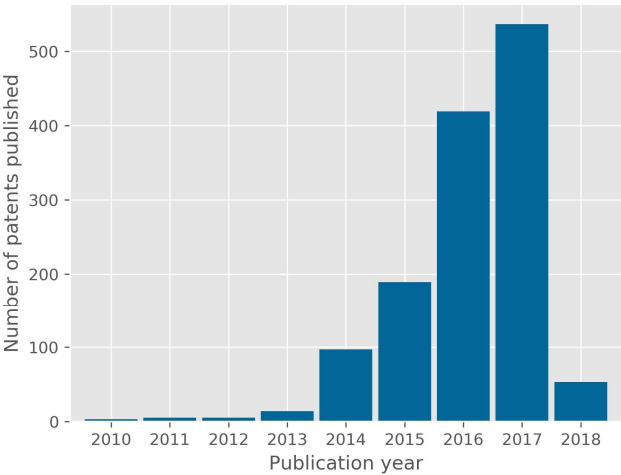
415 patents granted worldwide

Top countries - CN:201, KR:79, JP:56, US:42, GB:15, TW:12

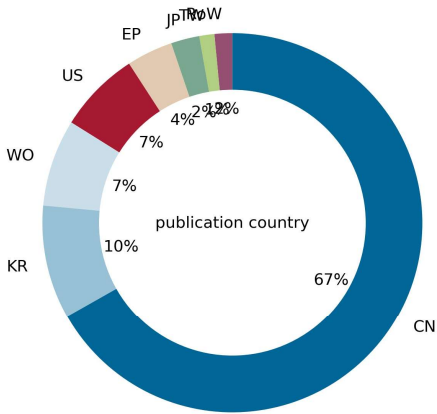


Academic assignees account for 1322 (55%) of the published patents, growth over the past two years overall, with Chinese publications accounting for nearly 67% of the filings

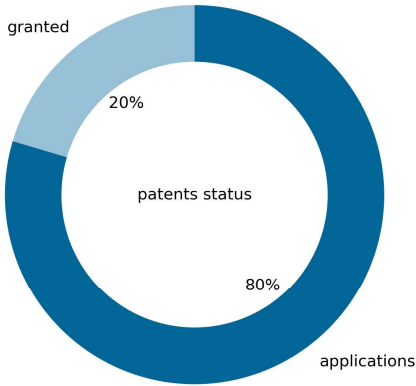
SO far 1322 patents have been published since 2010
Includes published patents up to February 2018



Worldwide patent publications – CN dominates
Less empahsis on international publications



So far 270 patents granted worldwide
Granted academic patents CN:164, KR:74, US:11, TW:10, JP:6, NL:1



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Analysis of all granted patents shows academic ahead, concentrated in China and Korea, commercial granted concentrated in JP, CN and US

Patent Applicants	No of patents filed	No. of patent families	No. of assignees	Patents per family	WO	US	EP	JP	KR	CN	RoW
all	415	374	173	1.1	-	46	6	51	78	207	27
commercial	135	106	41	1.3	-	29	5	43	6	37	15
academic	270	259	123	1.0	-	15	1	6	71	165	12
academic/commercial	8	8	7	1.0	-	2	-	2	1	3	-
independent	2	2	2	1.0	-	-	-	-	-	2	-

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Analysis of the top granted patent academic assignees shows them to be dominated by Chinese and Korean academics, the majority of granted patents are within a single country – some multi-family

Patent Applicants	No of patents filed	No. of patent families	No. of assignees	Patents per family	WO	US	EP	JP	KR	CN	RoW
bohai university	16	16	1	1.0	-	-	-	-	-	16	-
research and business foundation sungkyunkwan university	11	11	1	1.0	-	-	-	-	11	-	-
huazhong university of science and technology	9	8	1	1.1	-	-	-	1	-	8	-
korea research institute of chemical technology	9	8	1	1.1	-	2	-	-	7	-	-
institute of physics chinese academy of sciences	8	8	1	1.0	-	-	-	-	-	8	-
daegu gyeongbuk institute of science and technology	7	7	1	1.0	-	-	-	-	7	-	-
korea institute of science and technology	6	6	1	1.0	-	-	-	-	6	-	-
wuhan university	5	5	1	1.0	-	-	-	-	-	5	-
national institute for materials science	4	2	1	2.0	-	2	1	1	-	-	-
national cheng kung university	4	3	1	1.3	-	1	-	-	-	-	3
research and business foundation sungkyunkwan university global frontier center for multiscale energy systems	4	4	1	1.0	-	-	-	-	4	-	-
henan university of science and technology	3	3	1	1.0	-	-	-	-	-	3	-
national central university	3	2	1	1.5	-	1	-	-	-	-	2

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3: review of top twenty commercial assignees patent portfolio

evolution of patents

patent families

granted patents

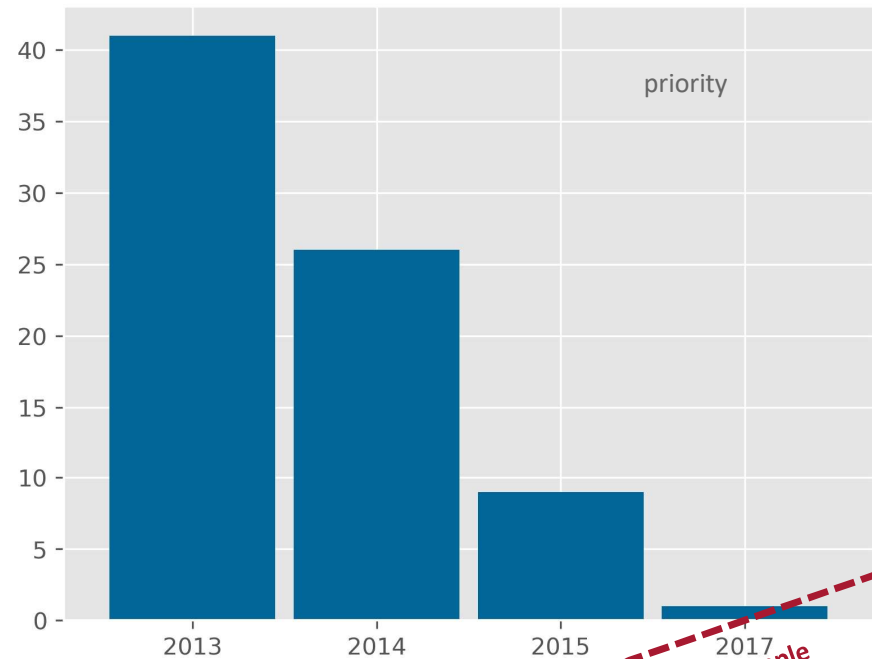
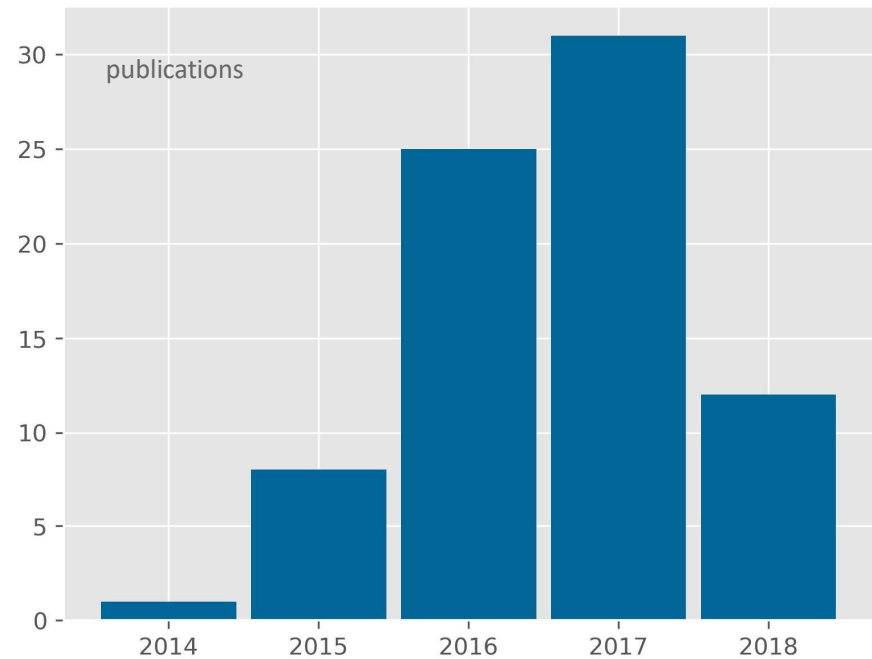
citation analysis

content analysis



Hunt Energy Enterprises LLC

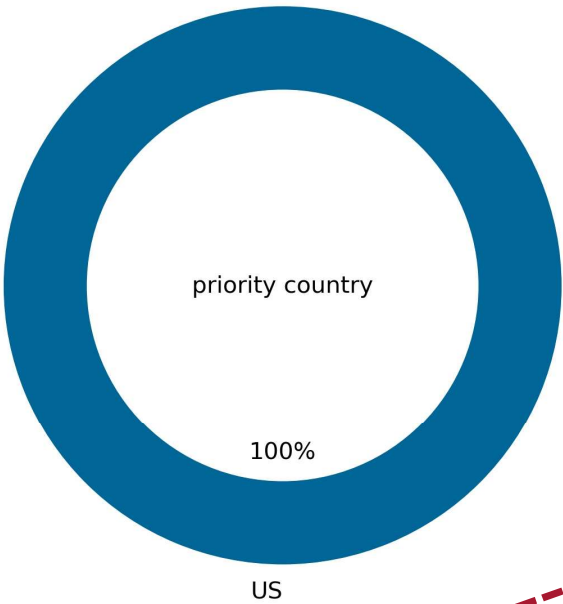
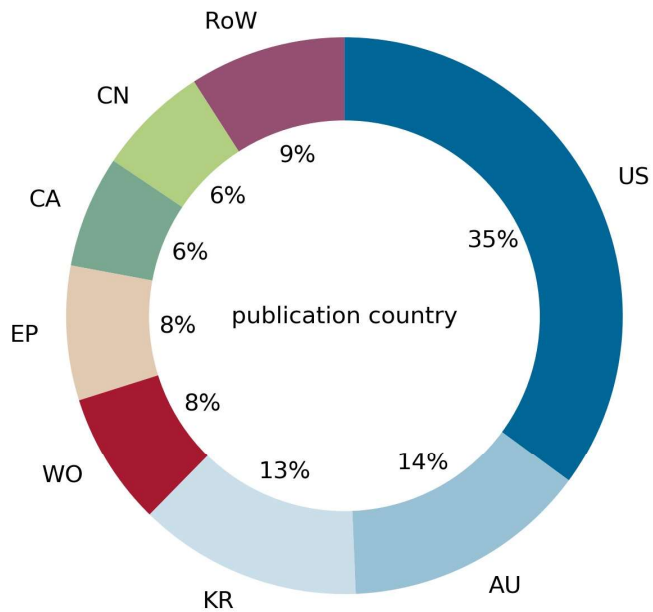
Priority and publication analysis



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Priority and publication country analysis



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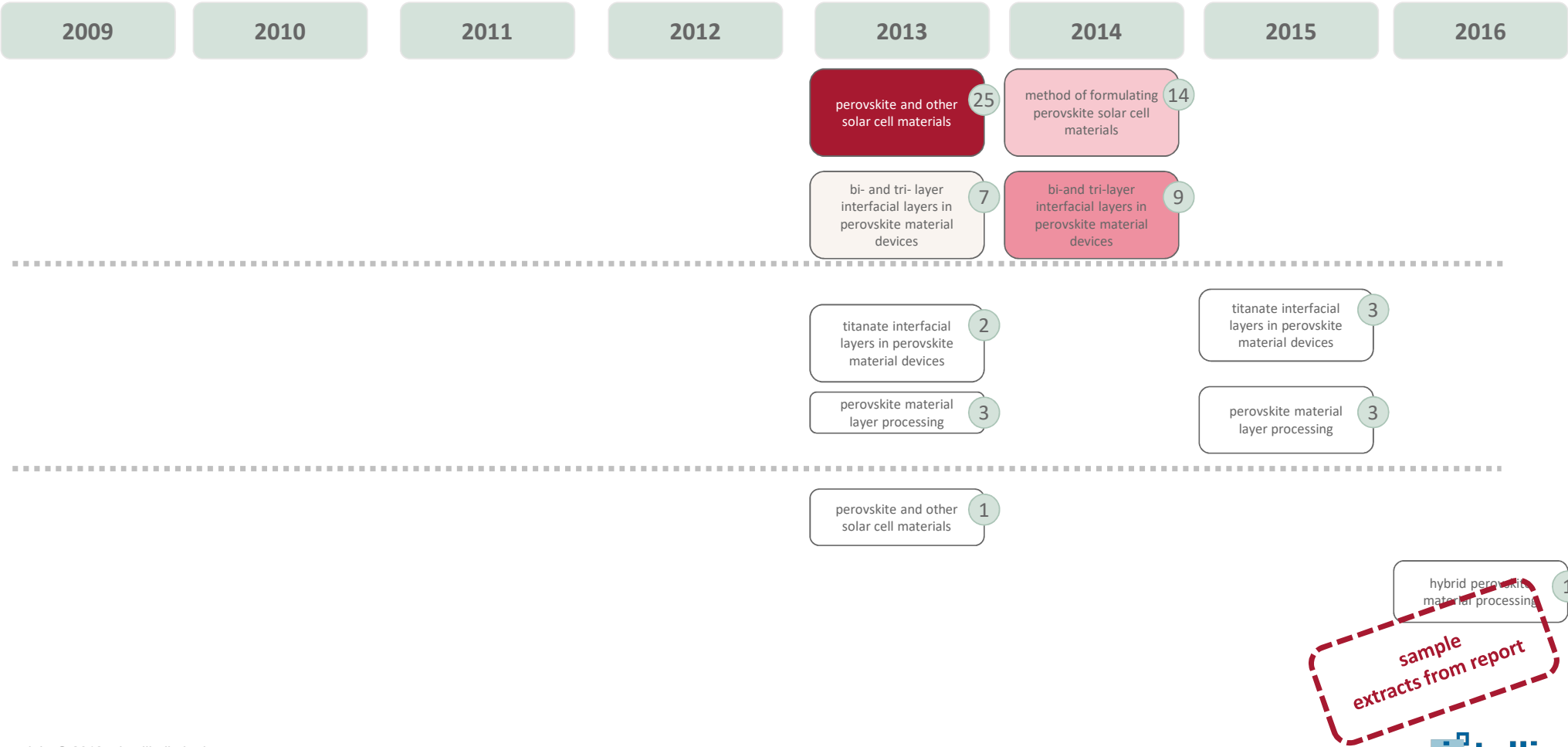
Patent family summary

Patent family title (id)	No of patents filed	No. of patent families	No. of assignees	Patents per family	WO	US	EP	JP	KR	CN	RoW
all	77	10	1	7.7	6	27	6	4	10	5	19
perovskite and other solar cell materials (53181619)	26	1	1	26.0	1	9	2	1	5	3	5
method of formulating perovskite solar cell materials (55180744)	16	1	1	16.0	1	3	2	2	2	1	5
bi-and tri-layer interfacial layers in perovskite material devices (56014543)	10	1	1	10.0	1	-	1	1	1	1	5
bi- and tri- layer interfacial layers in perovskite material devices (53882880)	8	1	1	8.0	-	8	-	-	-	-	-
titanate interfacial layers in perovskite material devices (57248549)	5	1	1	5.0	1	-	1	-	1	-	2
perovskite material layer processing (57757468)	4	1	1	4.0	1	-	-	-	1	-	2
perovskite material layer processing (54355859)	4	1	1	4.0	-	4	-	-	-	-	-
titanate interfacial layers in perovskite material devices (54007154)	2	1	1	2.0	-	2	-	-	-	-	-
hybrid perovskite material processing (61005431)	1	1	1	1.0	-	1	-	-	-	-	-

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Family evolution analysis - priority year of patent family with number of family members



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Biblio analysis

WO2014151522A1

perovskite and other solar cell materials

Photovoltaic devices such as solar cells, hybrid solar cell-batteries, and other such devices may include an active layer having perovskite material and copper-oxide or other metal- oxide charge transport material. Such charge transport material may be disposed adjacent to the perovskite material such that the two are adjacent and/or in contact. Inclusion of both materials in an active layer of a photovoltaic device may improve device performance. Other materials may be included to further improve device performance, such as, for example: one or more interfacial layers, one or more mesoporous layers, and one or more dyes.

1. A photovoltaic device comprising:
a first electrode;
a second electrode;
an active layer disposed at least partially between the first and second electrodes, the active layer comprising:
a perovskite, and
charge transport material comprising a copper-oxide compound.

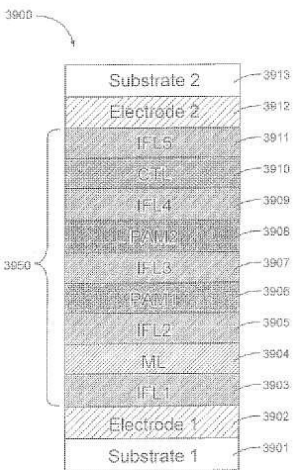


Fig. 36

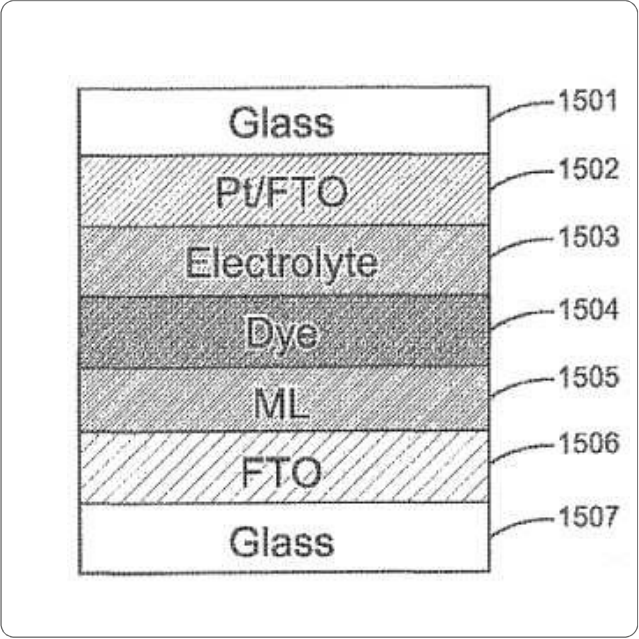
assignee applicant	hunt energy enterprises llc	publication date	2014-09-25
inventors	irwin michael d dhas vivek v maher robert d iii chute jerred a	priority claims	2013-03-15
classifications	H01L514213I H01L51422I Y02E10549A Y02P70521A	US20131389349 20130215	

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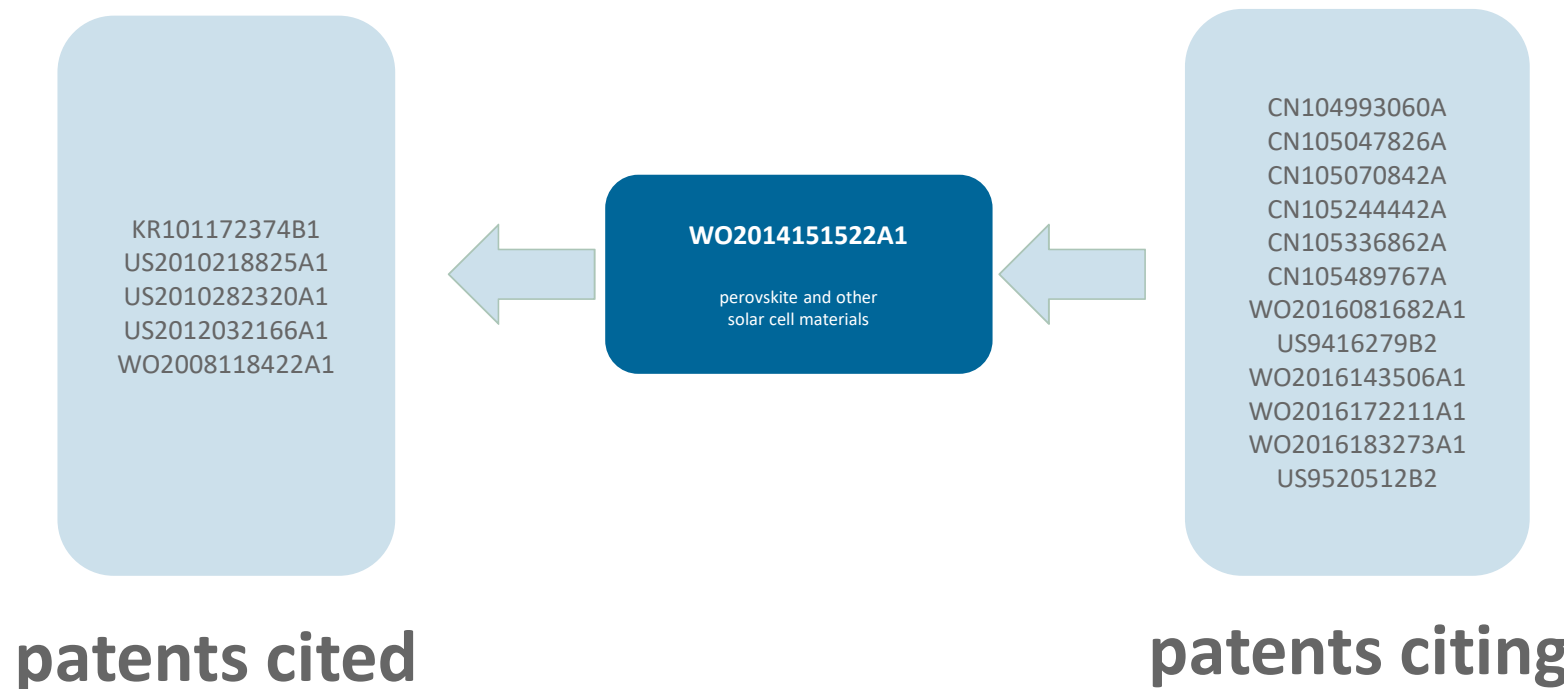
Biblio analysis

US2015144196A1	perovskite and other solar cell materials
<p>Photovoltaic devices such as solar cells, hybrid solar cell-batteries, and other such devices may include an active layer disposed between two electrodes, the active layer having perovskite material and other material such as mesoporous material, interfacial layers, thin-coat interfacial layers, and combinations thereof. The perovskite material may be photoactive. The perovskite material may be disposed between two or more other materials in the photovoltaic device. Inclusion of these materials in various arrangements within an active layer of a photovoltaic device may improve device performance. Other materials may be included to further improve device performance, such as, for example: additional perovskites, and additional interfacial layers.</p>	
<p>1. A photovoltaic device comprising: a first electrode; a second electrode; an active layer disposed at least partially between the first and second electrodes, the active layer comprising: photoactive material comprising a perovskite material; mesoporous material comprising NiO; and an interfacial layer comprising ZnO.</p>	



assignee applicant	hunt energy enterprises llc	publication date	2015-05-28
inventors	irwin michael d chute jerred a	priority claims	2013-11-26
classifications	H01G92027I H01G92059I H01L51422I Y02E10542A H01L51006A H01L510061A Y02E10549A H01G92009I H01L51448I H01L3118I H01L31053I	<div>US201414448053 20140731 US201414209013 20140317 US201363909168P 20131126 US201361913065P 20131209</div>	

Hunt Energy Enterprises LLC citation analysis - WO2014151522A1 (51580977)



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Hunt Energy Enterprises LLC
citation analysis - US2015144196A1 (53181619)



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