



Monthly OLED Emitting Material Patent Analysis Report - August 2020

Analyst
Dae Jeong YOON

1. Classification Method

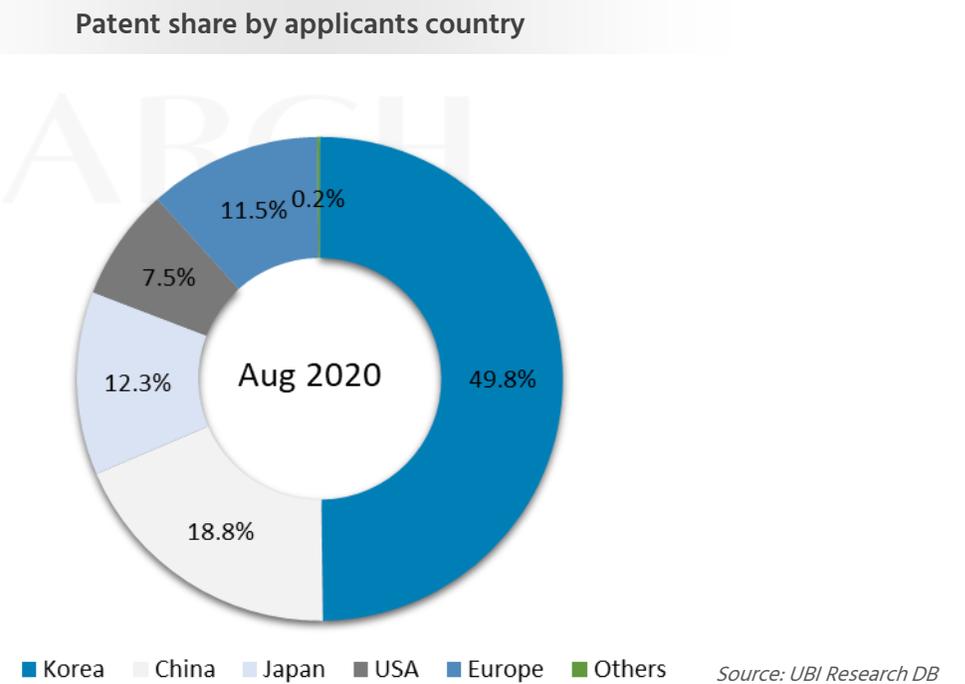
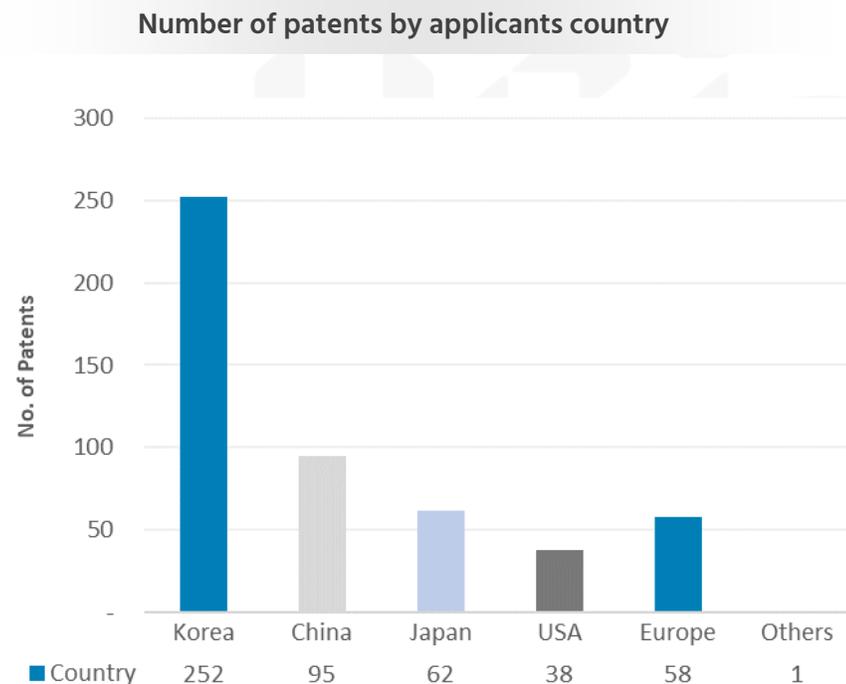
- Classified 499 patents published in August 2020 (application, under examination, registration).
- The classification method is as follows.
 - Applicants country
 - Classified into Korea, China, Japan, the United States, Europe, and others. If there are two or more applicants in a patent, the total number of applicant countries may exceed the number of published patents because the number of applicants is included in each country.
 - Major Companies
 - There are 15 companies, and the companies are as follows. Doosan Solus, Dow chem, Duksan Neolux, Idemitsu Kosan, LG Chem, Merck, Novaled, Samsung SDI, SFC, UDC, JNC, Hodogaya, Sumitomo, Kyulux, Cynora
 - Classification by materials(purpose)
 - Classified into EML, ETL, HTL, CPL, EML+HTL, EML+ETL, HTL+ETL, EML+HTL+ETL, and Others.
 - HTL included HIL, HTL, EBL, R', G', B'.
 - ETL included EIL, ETL, and HBL(aETL).
 - Others included QD, Near IR, CGL and so on.

Monthly OLED Emitting Material Patent Analysis Report - August 2020

2. Patent Analysis

By Applicants Country

- There were 499 patents published in August 2020, and if the patents that included more than two countries were classified, the total number of patents became 506.
- Out of the total number of 506 patents, Korea recorded the highest number of patents with 252.
- China ranked second with 95, followed by Japan with 62, Europe with 58 and the United States with 38.
- Among the total patents, the proportion of Korean applicants was 50%, 19% in China and 12% in Japan.

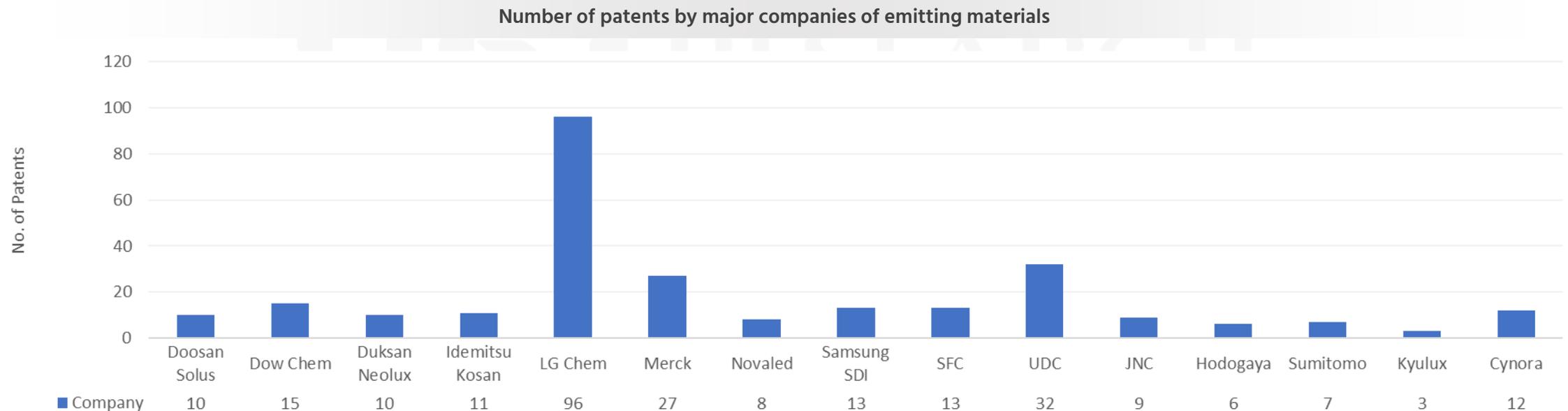


Monthly OLED Emitting Material Patent Analysis Report - August 2020

2. Patent Analysis

By Major Companies of Emitting Materials

- By major company, LG Chem recorded the highest number of patents with 96.
- LG Chem is supplying ETL to Samsung Display's OLED for mobile devices, and supplying a number of common layers and emitting layer materials for LG Display's mobile and TV.
- The second place was UDC with 32 patents, and the third place was Merck, who recorded 27.
- Cynora and Kyulux, which are developing TADF and hyper fluorescent, which are mentioned as next-generation emitting materials, recorded 12 and 3 patents, respectively.



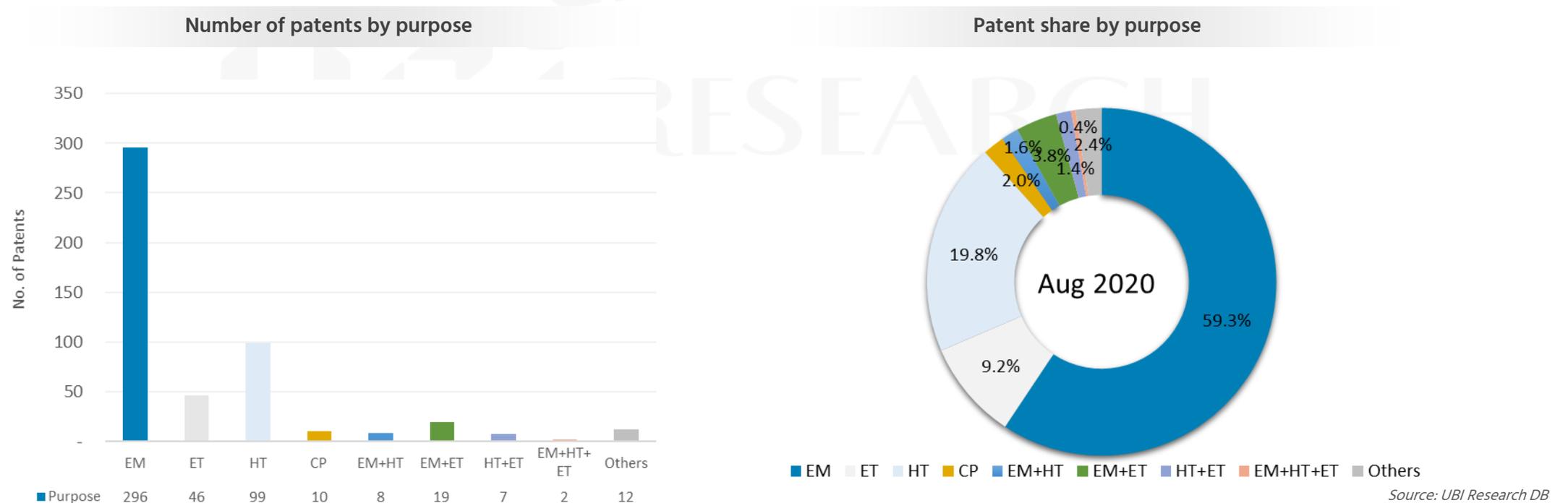
Source: UBI Research DB

Monthly OLED Emitting Material Patent Analysis Report - August 2020

2. Patent Analysis

By Purpose

- Patents by purpose are classified into layers such as HTL, EML, and ETL, and other patents.
- Among the total patents, the number of EML patents accounted for the largest share of 59% with 296, 99 for HTL, and 46 for ETL, accounting for 9%.
- Of the 12 other patents, the number of patents for CGL was the highest with 7.

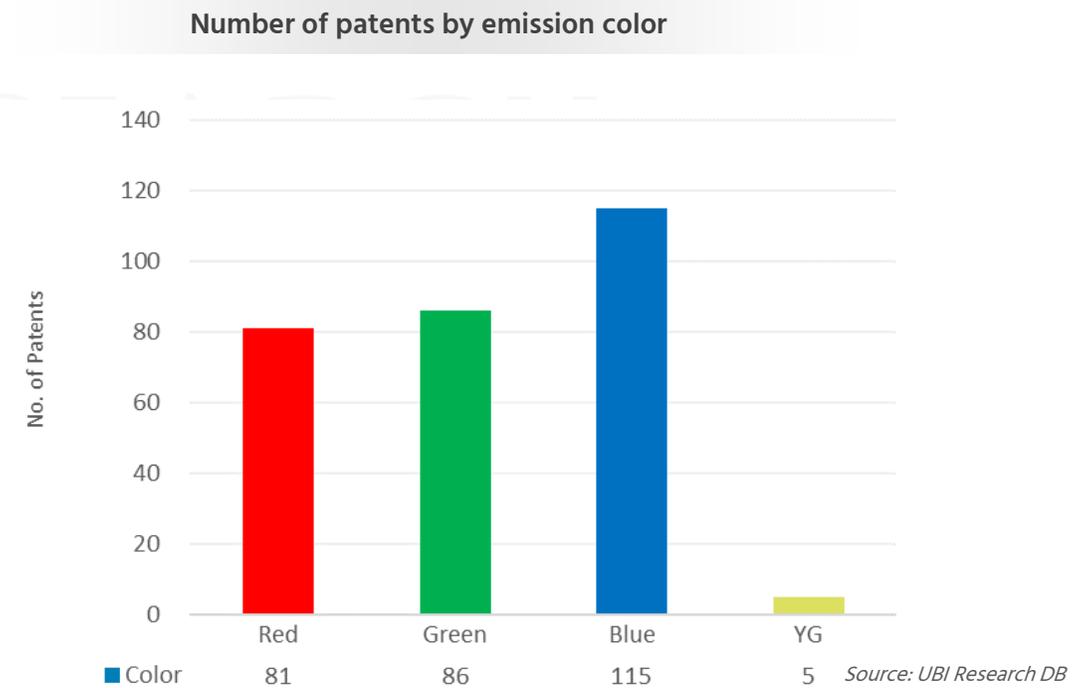
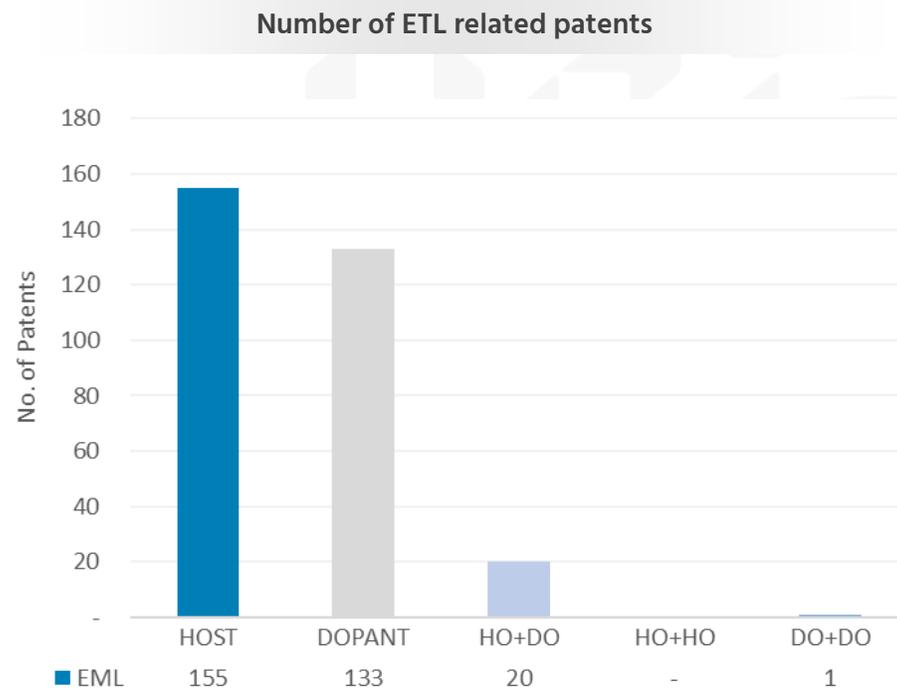


Monthly OLED Emitting Material Patent Analysis Report - August 2020

2. Patent Analysis

By Emitting Layer

- Among the patents related to the emitting layer, host-related patents recorded the highest number with 155, followed by dopant-related patents with 133.
- There were 20 patents related to host+dopant, and one related to dopant+dopant.
- In terms of color, blue-related patents recorded the largest number with 115, green with 86 and red with 81.
- There were 5 light green patents used for large area OLED.

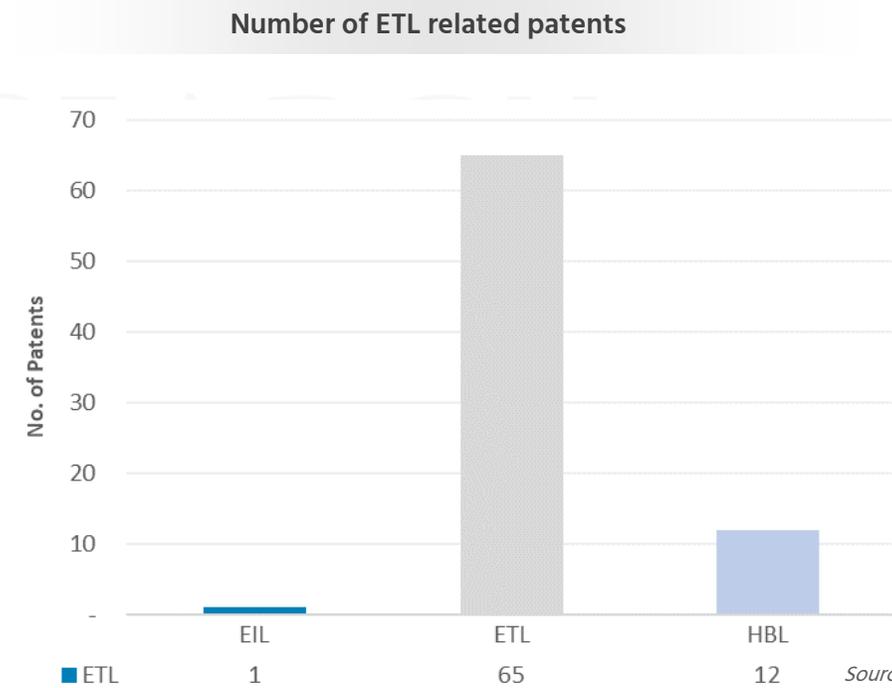
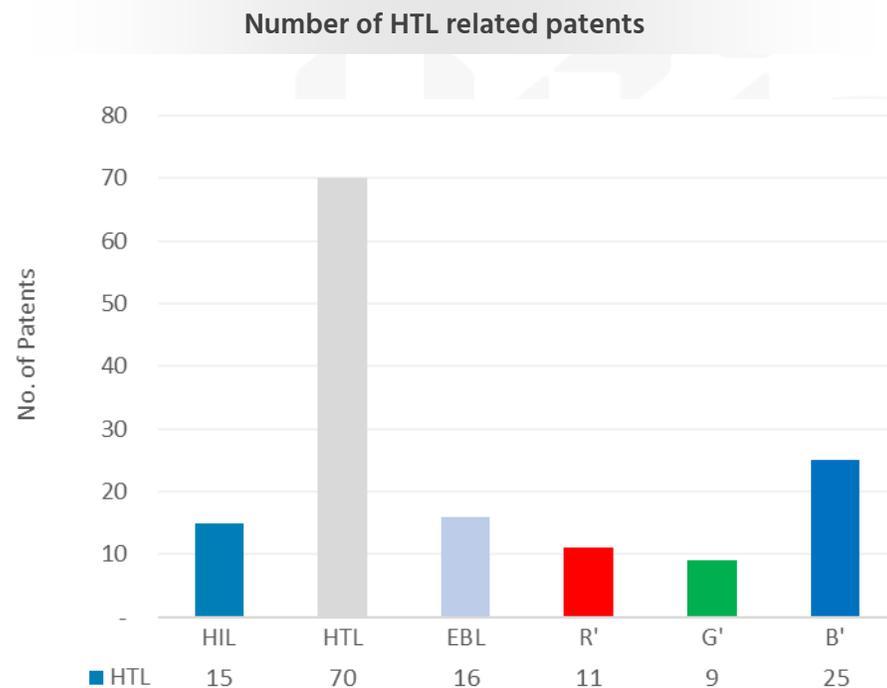


Monthly OLED Emitting Material Patent Analysis Report - August 2020

2. Patent Analysis

By Common Layer

- Among the HTL-related patents, HTL patents recorded the largest number with 70, followed by B' with 25 and EBL with 16.
- Companies that mainly mass-produce HTL are Idemitsu Kosan, Doosan Solus, and Duksan Neolux, while companies that mainly produce B' are Idemitsu Kosan and SFC.
- Among ETL-related patents, ETL recorded the highest number with 65, and HBL recorded 12.
- Companies that mainly mass-produce ETL include LG Chemical and LT Materials.



Source: UBI Research DB

3. Patents Review

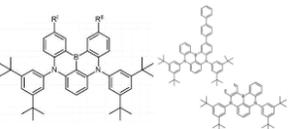
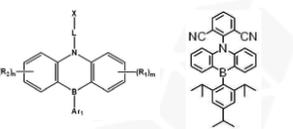
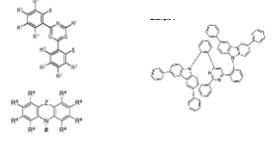
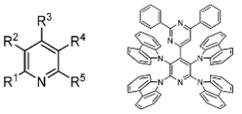
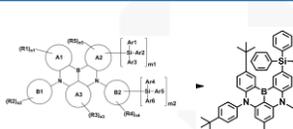
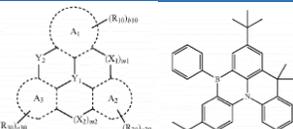
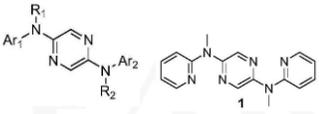
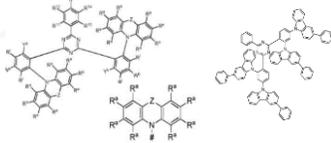
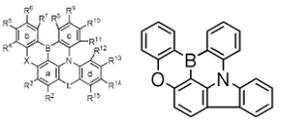
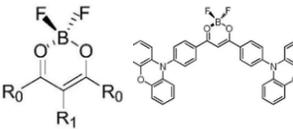
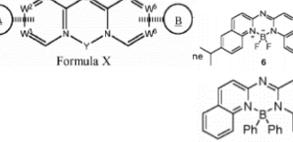
■ Blue Dopant Patents in Aug. 2020

- Blue dopant patents of 90 cases have been published or registered in Aug. 2020.
- Main assignees are Samsung display(12 cases), LG chem(11 cases) and Cynora(11 cases).
- Phenyl core TADF dopants substituted with various EDG and EWG ligands are the most. Cynora is pending these patents. Several companies, including JNC, have applied for patents on TADF materials containing boron. SFC registered the patent of DABNA fused dibenzofuran combined with anthracene host with deuterium.
- 17 blue phosphorescent dopant patents have been applied. Ir or Pt metal compounds with pyrazole or imidazole derivatives seem to emit blue.
- LG chem. and Merk applied for patents on florescent dopants such as amine substituted with benzofluorene or benzofuran derivatives.

Monthly OLED Emitting Material Patent Analysis Report - August 2020

3. Patents Review

BD_TADF

Boron Core		Pyrimidine Core		Pyridine Core	
<p>CYNORA GMBH US 16/787558 KR 10-2020-0016818 CN 2019-11376742 EP 2020-156089</p> <p>3,5-di-tert-butylphenyl</p> 	<p>SAMSUNG DISPLAY KR 2019-01-29 CN2020-10050970 EP 2020-152080</p> <p>Dibenzo azaborinine</p> 	<p>CYNORA GMBH EP 2018-799672</p> <p>2-Ph, 4,6-Ph-Cz</p> 	<p>KYULUX INC JP 2019-570920</p> 		
<p>LG Chem KR 10-2020-0017700 PCT-KR2020-002054</p> <p>Silyl</p> 	<p>SAMSUNG DISPLAY US 16/810626</p> <p>Dibenzo azaborino ~</p> 	<p>HUAQIAO University CN 2017-11093178</p> <p>diamine</p> 	<p>Triazine Core</p> <p>CYNORA GMBH EP 2018-800480</p> <p>2-Ph, 4,6-Ph-Cz</p> 		
<p>KWANSEI GAKUIN UNIV JNC CORP KR 10-2020-0017580 CN 2020-10089819</p> 	<p>GUANGDONG JUHUA PRINTED DISPLAY TECH CN 2019-10287869</p> <p>difluoro, dioxaborin</p> 	<p>University of Southern California KR 10-2020-0010334 CN 2020-10079135 EP 2020-153982</p> <p>triazaborinolo, 6-a:3,4-a'diquinoline</p> 			

* Yellow character : Registered

Monthly OLED Emitting Material Patent Analysis Report - August 2020

3. Patents Review

BD_TADF

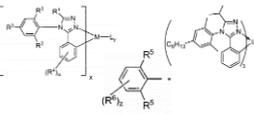
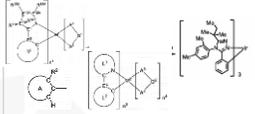
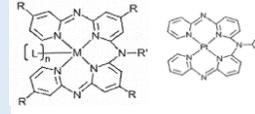
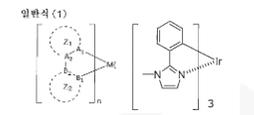
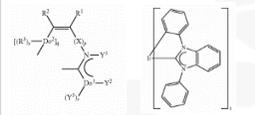
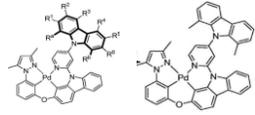
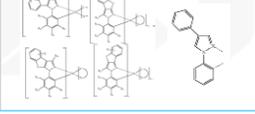
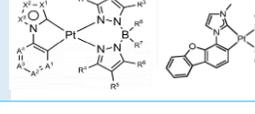
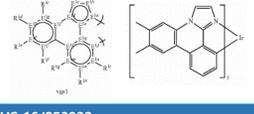
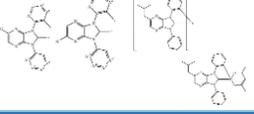
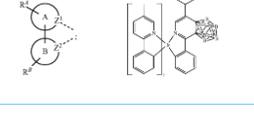
Phenyl Core			
<p>CYNORA GMBH EP 2018-800043</p> <p>Pyridine, Cz, Triazine</p>	<p>KONICA MINOLTA, Inc. KR 10-2017-7029655</p>	<p>GUANGDONG JUHUA PRINTED DISPLAY TECHNOLOGY CN 2019-10342575</p> <p>Benzodiazole</p>	<p>CSOT CN 2018-11378536</p> <p>spiro [acridine-9, 2'-adamantane] 1</p>
<p>CYNORA GMBH EP 2018-799673</p> <p>Fluorophenyl, Cz, Triazine</p>	<p>KYULUX INC JP 2019-570921</p>	<p>Samsung Electronics KR 10-2019-0017964 US 16/587429</p> <p>Benzoimidazole</p>	<p>CSOT US 16/858759</p> <p>Pyrido acridine</p>
<p>CYNORA GMBH EP 2018-782641</p> <p>Benzonitril-Cz, pyrimidine, Cz</p>	<p>IDEMITSU KOSAN EP 2016-772422</p> <p>1-Cz, 6-Triazine</p>	<p>SAMSUNG DISPLAY US 15/839740</p> <p>Cz, Ph-Cz</p>	<p>CSOT CN 2019-10098498</p> <p>Phnoxazine, acridine</p>
<p>CYNORA GMBH EP 10-2017-7022436</p> <p>1,3-EDG, 6-EWG</p>	<p>Merk EP 2018-165596</p>	<p>SAMSUNG DISPLAY KR 10-2019-0015192 CN 2019-11264753 US 16/678508</p>	
<p>CYNORA GMBH EP 2018-793179</p> <p>2,4-Pyrimidine, 3-Cz, 6-CN</p>			

* Yellow character : Registered

Monthly OLED Emitting Material Patent Analysis Report - August 2020

3. Patents Review

BD_PH

Ir Complex		Pt complex	
CDT Sumitomo Chem. EP 2016-723482 	CDT Sumitomo Chem. US 2016-723482 	Sumitomo Chem. EP 2018-860343 	R-Display & Lighting KR 10-2020-7019379 
TOSOH CORP KR 10-2018-7017959 	UDC US 16/798526 		SAMSUNG ELECTRONICS KR 10-2020-0008761 CN 2020-10078240 EP 2020-153874 ZHEJIANG University OF TECHNOLOGY CN 2020-10316814 
LG Display KR 10-2012-0118640 	The University of Southern California US 15/444592 		TECHNISCHE UNIVERSITÄT DRESDEN PCT-EP2020-054656 
UDC US 16/511090 			
UDC US 16/853032 			
UDC US 15/915385 			
			Au complex THE UNIVERSITY OF HONG KONG CN 2019-80007327 

* Yellow character : Registered

Monthly OLED Emitting Material Patent Analysis Report - August 2020

3. Patents Review

BD_FL

Benzofluorene	
JILIN OPTICAL AND ELECTRONIC MATERIALS	CN 2017-11444628
Diamine	
LG chem	KR 10-2019-0009487
phenylbenzofluorene amine	
Merk	KR 10-2015-7008598
Amine	

Spirobenzofluorene	
LG chem	CN 2019-80006388
Diamine	

Indeno phenanthrene	
SAMSUNG DISPLAY	KR 10-2013-0070487
Amine	

Naphthobenzofuran	
LG chem	KR 10-2020-0011756 PCT-KR2020-001480
Diamine	
LG chem	KR 2019-80007580
Diamine	

Fluorenobenzofuran	
Merk	EP 2018-788736
Amine	

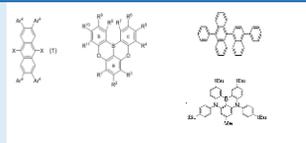
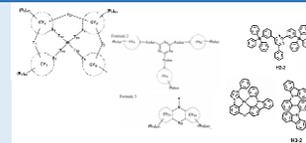
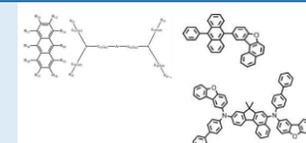
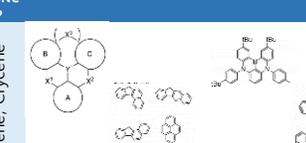
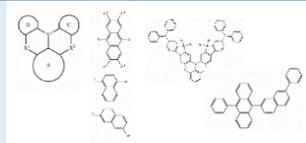
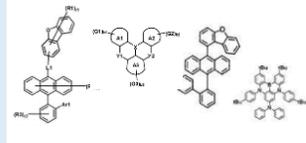
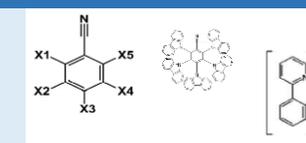
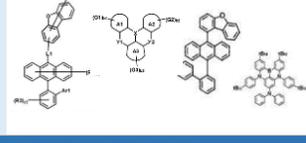
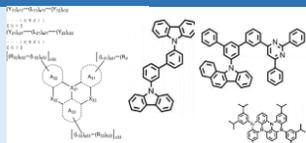
etc.	
NANJING TOPTO MATERIALS	CN 2016-09-30
SUZHOU JIUXIAN NEW MATERIAL	CN 2020-10537258
quinoxaline-3,2,1-dejacridine-5,9-dione	

* Yellow character : Registered

Monthly OLED Emitting Material Patent Analysis Report - August 2020

3. Patents Review

Combination

		BH+BD				2 stack blue, BD+BD	
Boron		Pt complex		Ar, Hetaryl-diamine		Boron	
KWANSEI GAKUIN UNIV JNC CORP KR 10-2020-0011039		Samsung Display EP 2019-163558		Samsung Display CN 2020-10307116		KWANSEI GAKUIN UNIV JNC CORP JP 2020-012206	
Anthracene				Dibenzofluorene, Pyrene, Cycene			
KWANSEI GAKUIN UNIV JNC CORP US 16/617296						BD+BD	
Anthracene						5Cz1CN	
LG chem CN 2019-80008471						LG chem KR 10-2016-0122411	
Phenylanthracene						PH dopant	
e-dibenaofuran							
SFC KR 10-2019-0091889						BD+aETL	
D substituted Ar-anthracene-dibenaofuran						~fluoreno benzofuran	
Samsung Display JP 2019-067275						SFC US 15/746233	
n-host + p-host						benzoquinazolin e, triazine, anthracene	

* Yellow character : Registered



Analyst
Dae Jeong YOON