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**China Automotive Smart
Glass Research Report,
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Smart glass research: the automotive smart dimming canopy market valued at RMB127 million in 2022 has a promising future.

Smart dimming glass is a new type of special optoelectronic glass formed by compounding a liquid crystal film into the middle of two layers of glass and bonding them under high temperature and high pressure. By implementation mode, it falls into electrically controlled, temperature-controlled, optically-controlled and pressure-controlled types.

In the automotive field, there are four major types of dimming glass: polymer dispersed liquid crystal (PDLC), suspended particle devices (SPD), electrochromic (EC) and dye liquid crystal (Dye LC). Wherein, PDLC, SPD and Dye LC feature physical dimming, and EC chemical dimming.

* PDLC appeared first. As the most mature and lowest cost technology, the majority of Chinese dimming glass manufacturers are using the solution;

* SPD is mainly used in high-end models such as Mercedes S/SL and yachts due to high power consumption and high cost;

* Dye LC spends a relatively short time on dimming using dichroic dye molecules;

* EC features low haze, low energy consumption, good thermal insulation effect, continuous dimming, relatively long dimming time (2min on average) and medium cost.

Comparison between Automotive Dimming Glass Technologies

Performance	PDLC	SPD	Dye LC	EC	
SOP	2001	2011	2021	2005	
Visible light transmittance	Transparent	85	65	/	60~70
	Coloring	64	0.7	/	1
NIR transmittance	Transparent	Basically unobstructed	77.6	/	30~40
	Coloring	Basically unobstructed	27.4	/	0
UV transmittance	Transparent	0.5	0.1	/	0.1
	Coloring	0.5	0.1	/	0
Shading coefficient	Transparent	0.79	0.66	/	0.48~0.71
	Coloring	0.63	0.07	/	0.02~0.08
Transmittance	52%~81%	/	1%~38%	1%~65%	
Adjustable brightness	Two states	Continuously adjustable	Continuously adjustable	Continuously adjustable	
Working temperature	-30~80°C	-20~60°C	-20~85°C	-40~90°C	
Maximum size	1500*5000 mm	1040*3200 mm	/	1500*3000 mm	
Color	Bronze, green, gray	Blue	Gray-black	Blue, grey	
Haze	5~10%	/	< 5%	0.22%	
Operating voltage	45V AC	110V AC	30V AC	3V DC	
Energy consumption	5~10 W/m ²	0.55~2.0 W/m ²	/	0.4~1.0 W/m ²	
Response time	160~7 ms	1~3 s	< 1 s	< 6 min	
Service life	< 15 y	> 20 y	> 20 y	> 20 y	
Substrate	Glass	Glass, acrylic, polycarbonate, composite glass	Glass	Glass	
Price	Low	High	Medium	Medium	

Source: ResearchInChina

Smart dimming glass is often applied to panoramic canopies and may be applied to side windows and front windshield among others

At present, smart dimming glass is often applied to panoramic canopies, not only giving a deeper spatial impression but also automatically reducing the transmittance of ultraviolet and infrared rays in the blazing sun for the purpose of lowering the temperature inside. According to the data from ResearchInChina, 1,636,900 units of new passenger cars in China were installed with panoramic canopies in 2022, 0.5% of which were smart dimming canopies. It is expected that panoramic canopies will be installed in 3,684,100 units of new passenger cars in 2025, 6.1% of which will be smart dimming canopies.

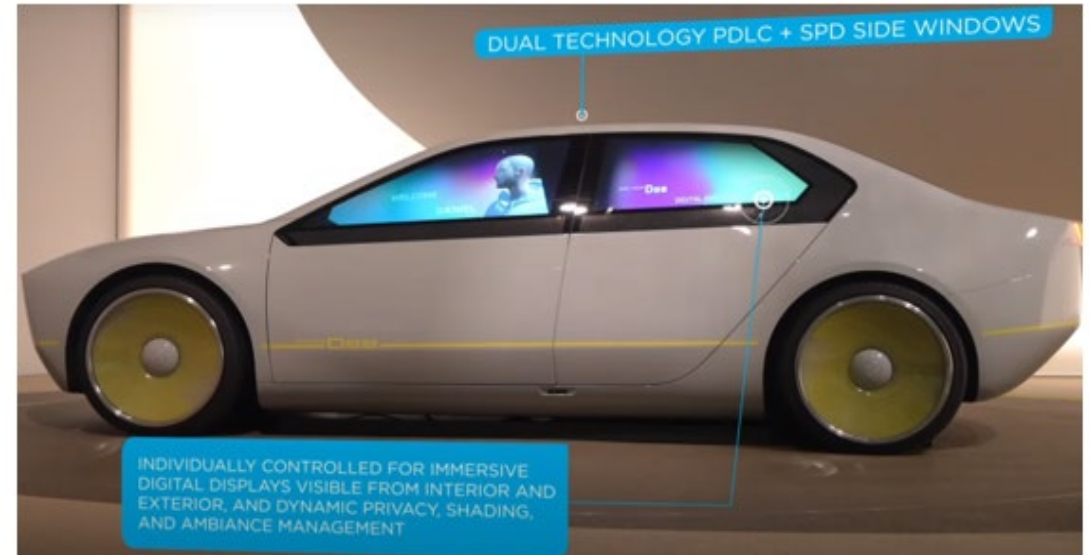
In this report, the panoramic canopy refers to: non-opening large-size sunroof without segmental structure; the dimming canopy means: enabling the smart dimming control function on the basis of panoramic canopy.

In the future, smart dimming glass may be applied to side windows and front windshield among others. For example, the side windows can display advertisements (displaying when the vehicle is stopped and becoming transparent when the vehicle is started and power on), and offers backseat graffiti function for children, human-computer interaction, entertainment and other capabilities; the front windshield incorporates AR HUD for anti-glare: combined with the front view camera, recognize the high beam of the oncoming vehicle, and automatically adjust the transmittance of the front windshield to eliminate glare and ensure safe driving.

BMW iVISION Dee Concept features Gauzy's PDLC and SPD smart glass technologies

At the CES 2023, BMW iVISION Dee Concept car that features Gauzy's PDLC and SPD smart glass technologies was showcased. The front windshield enables the HUD to provide wide viewing angles for a virtual image for all passengers; the side windows support dynamic privacy, shading, and ambiance management.

The segmented SPD-LCG? smart glass windshield for BMW iVISION Dee enables the HUD to provide wide viewing angles for a virtual image.



Source: Gauzy

Smart dimming glass industry chain

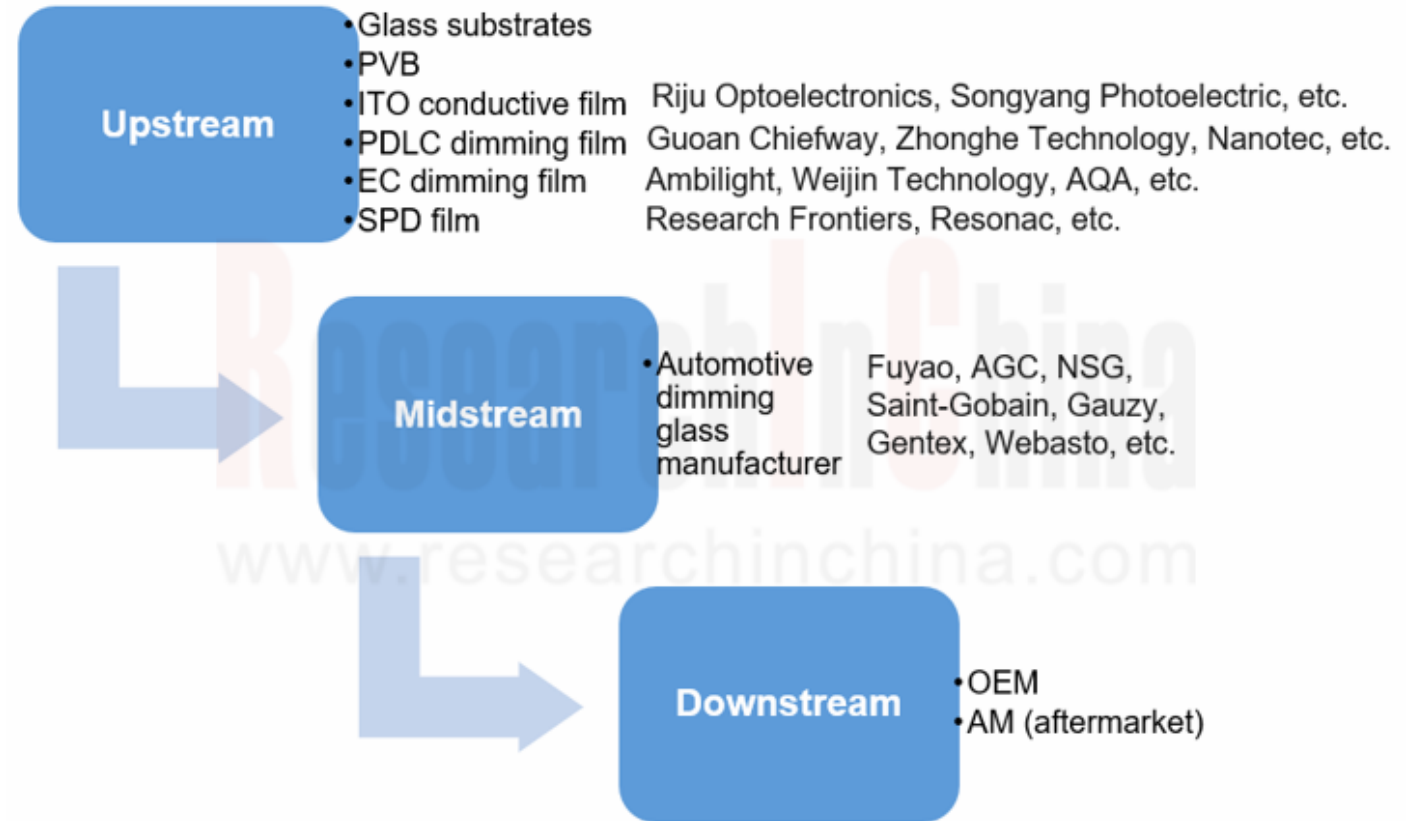
From the smart dimming glass industry chain, it can be seen that the upstream is mainly engaged in production of relevant dimming materials, films, glass substrates and PVBs; the midstream is responsible for integrating dimming glass that is applied to OEM markets and aftermarkets. The upstream and midstream manufacturers first started from deploying patents. Among the global top 1,000 companies by patent filings, the first five companies are BOE, Nitto Denko, Ricoh, Sony and Fuyao, of which most patents of BOE and Fuyao are filed during 2019-2022.

For example, in May 2019 BOE filed the CN 210514886 U Dimming Glass Patent, a display window technology patent in which the dimming glass layer is set up with basic dimming structure and functional dimming structure: the former is used to adjust the transmittance of light shining onto it, and the latter is used to reflect the light of a specific waveband shining onto it.

From the prospective of smart dimming glass supply, the key suppliers are Fuyao, AGC, NSG, Gauzy, Saint-Gobain, Ambilight, and Research Frontiers. Among them, Fuyao remains absolutely dominant, thanks to its stable supply relationships in the automotive glass market, as well as factors such as dimming glass technology R&D, cost balancing and occupant experience.

In the OEM market, the installed models include Toyota Venza, BYD Seal, Neta S, Lotus Eletre, NIO EC7, Porsche Taycan, Lexus RZ, and Cadillac CELESTIQ (not mass-produced). Among them, the dimming canopy glass surface of Porsche Taycan is split into nine individually controlled areas, and offers five dimming effects: transparent, matte, translucent, vivid, and user-defined. In the future, as consumers demand more beautiful, more comfortable and more intelligent vehicles, smart dimming glass will usher in a boom period in other fields in addition to panoramic canopy.

Automotive Dimming Glass Industry Chain



Source: ResearchInChina

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Beijing Headquarters

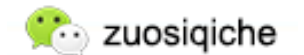
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