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Advanced Display

Switchable Dye Liquid Crystal Privacy Technology

Background

With the increasing popularity of privacy technology in scenarios such as business laptops and in-vehicle passenger screens, the market demand for high-performance switchable anti-peeping solutions is constantly rising. However, at present, there is no dye liquid crystal material that can simultaneously meet the requirements of high share and privacy ratio, low transmittance loss, and switchable privacy function. Therefore, it is necessary to develop new dye liquid crystal materials and switchable anti-peeping technologies to break through the existing performance bottlenecks.

Research Objectives

- Develop novel dye liquid crystal materials compatible with the LCD ODF process
- Explore switchable privacy protection technologies with a high shared-to-privacy ratio and high transmittance

Key Specifications

- Shared-to-privacy ratio⩾12:1@45°
- Transmittance⩾70%
- Driving voltage⩽6V

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Dye-Based Polarizer for 3D Printing

Background

In the 3D printing curing process, ultraviolet light sources are modulated by liquid crystal displays to selectively expose photosensitive resins, enabling layer-by-layer curing, accumulation, and shaping. Currently, dye-based polarizers used in LCDs for 3D printing offer good durability and long lifetimes, but their costs remain excessively high. Therefore, developing low-cost dye-based polarizers without compromising service life is a key challenge for advancing 3D printing curing processes.

Research Objectives

- Develop a low-cost, dye-based polarizer specifically designed for 3D printing applications

Key Specifications

- Ts (Transmittance Single Plate)⩾38%@405nm
- Polarization⩾99.99%
- Stable under 60℃/ 90% RH for 1000 hours
- Possess a significant cost advantage

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High-Strength Aluminum Alloy Materials

Background

As display products continue to evolve toward ultra-thin designs, their overall mechanical strength diminishes, leading to increased instances of defects such as chipping, warping, and static/dynamic pressure marks. Existing backplane reinforcement solutions often result in fractures or cracks under current stamping processes, failing to meet the requirements for quality and mass production applications. Therefore, it is necessary to further enhance the strength of the backplane to improve the overall structural integrity of the module.

Research Objectives

- Develop high-strength aluminum raw materials
- Research on stamping processes for high-strength aluminum alloys

Key Specifications

- Strength: Tensile strength 450 MPa, yield strength 380 MPa
- Thickness: 0.15mm~0.4mm
- Process compatibility: Suitable for cold stamping processes and L-bends or U-bends without cracking, with finished product warpage⩽0.5mm

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Reverse-Dispersion Liquid Crystal and Retardation Film Materials

Background

In the current LCD industry, both the liquid crystal materials and waveplates are normal dispersion materials.

The refractive index differences (△n) of liquid crystal materials at wavelengths of 450nm (blue), 550nm (green), and 650nm (red) are roughly in the ratio of 11:10:9. This leads to relatively low utilization rates of blue and red light, causing a yellowish tint when light passes through the Filter On Glass (FOG). To achieve the target white color coordinates, backlight units need to use LEDs with lower color temperatures, which consume more power to reach the same brightness levels. If reverse-dispersion liquid crystal materials were used, with △n ratios at 450nm (blue), 550nm (green), and 650nm (red) closer to 9:11:13, it could not only improve panel transmittance but also reduce module power consumption by adjusting the LED color blocks.

Moreover, since current quarter-wave plates are normal dispersion types, only specific wavelengths can perfectly convert linear polarization to circular polarization, while other wavelengths convert to elliptical polarization instead. The ellipticity across various wavelengths is approximately 0.9, leading to noticeable color shifts from different viewing angles when using polarized sunglasses, affecting the "Sunglass Free" experience. Products using Pancake or Birdbath optical paths also suffer from issues like ghosting and color distortion due to the low ellipticity of light within these systems. If the waveplate were made from reverse-dispersion materials, with wavelength dispersion closely matching the ideal quarter-wave plate curve, these problems could be mitigated. If retardation films are made from negative dispersion materials with wavelength dispersion close to the ideal quarter-wave curve, the above issues can be effectively resolved.

Research Objectives

- Develop novel optical materials with negative dispersion properties
- Investigate the application potential of reverse dispersion optical materials in the LCD industry.

Key Specifications

- Liquid crystal: △n ratio at 450nm, 550nm, and 650nm approaching 9:11:13
- ¼Waveplate: Wavelength dispersion closely matches the ideal curve（Retardation=$\frac{\lambda}{4}$）, Ellipticity across the entire wavelength range＞0.98

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Optical & Mechanics Simulation Model of Dark State Non-uniformity

Background

In large-sized display products, the optical changes caused by uneven force on the panel structure result in the adverse phenomenon of uneven dark states. Currently, there is a lack of models that simulate mechanics and optics to analyze the dark state non-uniformity caused by structure or touch under different design conditions

Research Objectives

- Based on the stress distribution of large-size panels and the degree of dark-state non-uniformity, establish a coupled mechanical-optical simulation model to analyze the impact of panel stress on dark-state non-uniformity under different optical film sizes and configurations, and derive optimization schemes.

Key Specifications

- Establish a mechanical-optical simulation model and provide simulation results of dark-state non-uniformity

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Anti-Reflection and High-Transmission Organic Materials

Background

Display products adjust screen brightness according to outdoor ambient light intensity to provide optimal visual performance. However, ambient reflected light reduces screen contrast, significantly affecting both display quality and camera imaging. Therefore, it is necessary to optimize the anti-reflection and transmission properties of materials to enhance outdoor display performance.

Research Objectives

- Develop novel high-transmittance, low-reflection filling/substitution materials compatible with existing optical film stacks

Key Specifications

- PFAS Free Material
- Reflectance SCI⩽4% (380–780 nm); Transmittance⩾80%@3μm (430–480nm, 520–555nm, 605–680nm, ⩾940nm); Transmittance⩽1% at other wavelengths
- Refractive index:1.5-1.6@380-780nm
- UV Test ΔE:120W 300hr
- Baking temperature⩽80℃

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High-Modulus Epoxy Adhesive Materials

Background

Current foldable filling materials have low modulus, and their filling processes are complex and costly. To improve product impact and drop resistance while reducing frame thickness, it is necessary to develop low-cost, high-performance epoxy adhesive materials.

Research Objectives

- Develop high-modulus epoxy dispensing materials for 3D printing to reduce module frame thickness and enhance overall drop reliability

Key Specifications

- Elastic modulus⩾2GPa
- Viscosity: Material ① 10^6 ±10% mPa.s； Material ② 140-180 mPa.s
- Photocuring wavelength: ~470 nm; Curing energy: ~72000 mJ; Curing time: ~90 s
- Hardness: 73D
- Elongation at break⩾10%
- Glass transition temperature (Tg): 75 ± 2 °C
- Water absorption⩽1%

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Fast Response Liquid Crystal

Background

Vertigo is the major obstacle to the advancement of VR products, with screen motion blur being a primary contributing factor. Increasing the display refreshing rate can effectively reduce the motion blur. Therefore, there is a growing demand for the grey-to-grey response time (GTG) of liquid crystal (LC) materials.

Research Objectives

- Develop liquid crystal materials with faster GTG response while maintaining high transmittance and contrast

Key Specifications

- GTG Max $\leqslant$3.0ms @1.8 μm Cell Gap

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Ultra-high PPI OLED Optical Performance Enhancement

Background

Ultra-high PPI top-emitting OLED displays need to meet high optical performance and be compatible with the optical mechanism system, and the light-emitting path should be limited within the designed area to achieve target optical efficiency and suppress stray light effects (such as ghost, halos, speckles, MTF distortion, etc). To further enhance the display effect of ultra-high PPI OLED, it is necessary to develop high-performance optical materials and structures.

Research Objectives

- Develop low temperature material which featuring high-transmittance / anti-reflectivity, with adjustable thickness
- Develop high-spatial-precision, low-Tr black matrix (visible light filtering) or ultra-low Tr blue materials with adjustable thickness, to feature stray light suppressing
- Develop micro-lens materials or process technologies, low-temperature curing, with controllable morphology and optical parameters (n-k)

Key Specifications

- Low-temperature curing material for high-Tr, or anti-reflection, or thickness adjustment: Tr＞98%@460nm; refractive index n: 1.50-1.65; thk: 0.2-1.0μm; viscosity: 2.0-4.0cp
- Low-temperature, high-spatial-precision, and low-Tr BM (black/dark blue/dark red): n: 1.50-1.65; thk: 0.6-1.2μm; viscosity :3.0-6.0 cp; resolution <0.5μm; Baking time: 15 minutes.; White-Y Tr <3%
- Micro-lens array (self-flowing/transfer/imprinting): Tr>98%@460nm; n>1.61; thickness: 1-4μm; viscosity:8.0-12.0cp; curing temperature<100 ℃ ; lens diameter:2-5μm, resolution (space):CD <0.3μm
- All materials must meet Out-gassing<1% (TGA); Process temperature <90℃

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AR/VR Lightweight and Thinness Optical-engine Solution

Background

Users' demands for the thinness, comfort and high performance of AR/VR devices are increasing. The existing optical engine modules, due to their large size and heavy weight, limiting the portability and immersive experience. Through innovative optical design and material technology, the size and weight of the optical engine can be significantly reduced to enhance the display effect and provide a more comfortable wearing experience.

Research Objectives

- Develop a new ultra-thin optical engine solution with high display quality, high luminous efficiency, and manufacturability

Key Specifications

- Pancake: Thickness⩽15mm, field of view⩾100°, weight⩽25g
- Birdbath: The weight of the single-eye module⩽10g, thickness⩽14mm, FOV⩾50°
- Geometric wave-guide: single-eye module⩽10g, lens thickness⩽1.5mm, white light guiding optical efficiency⩾10%, FOV⩾30°
- Other high-performance optical engine solutions

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Photoluminescence Degradation Mechanism and Improvement Strategies of Perovskite Quantum Dots

Background

As a promising core material for next-generation display technologies, perovskite quantum dots have become a focus in the display field due to their advantages such as high quantum yield and narrow full width at half maximum. However, the poor photoluminescence stability of blue-light quantum dots remains a bottleneck: due to surface defects catalyzing lattice decomposition, their half-life under strong light is relatively short, far below commercial requirements. Existing passivation methods either lack sufficient stability or sacrifice luminescence efficiency, and the mechanisms of ion migration and defect evolution await in-depth analysis.

Research Objectives

- Investigate the degradation mechanism of perovskite quantum dots under blue light illumination
- Propose corresponding optimization strategies from the material perspective to ensure their stability under blue light illumination

Key Specifications

Under blue light illumination (450~460nm, 1000 nits), the stability shall meet the following requirements:

- T95 (5% degradation of PLQY)⩾240h, T80 (20% degradation of PLQY)⩾1000h

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Development of Long-Lifetime Blue QLED

Background

QLEDs (Quantum Dot Light-Emitting Diodes) have attracted widespread attention in both academia and industry due to their high color gamut, stability, and tunable emission spectra. Currently, the lifetime of blue QLEDs is one of the key challenges for the industrial application of AM-QLED displays. It is urgent to explore technical solutions to improve blue QLED lifetime from the perspectives of device degradation mechanisms, materials, and device structures.

Research Objectives

- Investigate the degradation mechanisms of blue QLED devices
- Develop high-efficiency, stable blue quantum dots (QDs) and transport layer materials
- Develop long-lifetime blue QLED device structures

Key Specifications

- EQE⩾20%
- LT95⩾400h@1000nits
- Wavelength：450-470nm

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Simulation and Analysis of Stress Difference in Double-Sided Thin Films on Glass Substrates

Background

Glass substrates are regarded as the next-generation base materials for advanced packaging. During the process of double-side deposition, there are stress differences between the top and bottom layer, leading to film cracking and production yield reduction. This project aims to explore the simulation methods to analyze the characteristics and causes of these stress differences, with the objective of optimizing process parameters and enhancing the reliability of thin-film structures.

Research Objectives

- Simulate the structural stress in the front and backside thin films
- Investigate the stress differences between the two sides and the underlying causes of crack formation
- Explore optimization strategies for crack mitigation through simulation analysis

Key Specifications

- Analyze film stress distribution in the temperature variation ranging from 25°C to 260°C
- Crack-free thin-film process recipe withstand 20 times Multi-Reflow

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Development of Advanced Materials for Glass-Based Advanced Packaging

Background

Glass substrate has great potential in the next-generation packaging. During the tape-out process, it is prone to problems such as poor edge bonding, easy to be crushed, and chipped edges during unit cutting. Therefore, it is urgent to develop panel-level and unit-level edge coating materials and processes to enhance the reliability of glass substrate wafer fabrication. Moreover, as an interposer, the glass substrate is used to achieve high-integration packaging, and it is necessary to develop fine-line dielectric materials that match the requirements.

Research Objectives

- Develop panel-level edge coating materials and processes with acid-alkali resistance, oxidation resistance, and high temperatures resistance
- Develop unit-level edge coating materials and processes with low temperature resistance and high temperature resistance
- Develop dielectric materials with low curing temperature, high resolution, low signal loss, and low viscosity characteristics

Key Specifications

- Panel-level edge coating material: Acid-alkali resistance processes; Strong oxidation (by $KMnO_4$) resistance, and high-temperature resistance (＞190°C)
- Unit-level edge coating material: High temperatures resistance (＞260°C, MR 15 times); High-low temperature cycling resistance ranging from -55°C to 125°C (700 TCT cycles)
- Fine-line dielectric material: Curing temperature≤180°C; Resolution≤5 μm@7 μm thickness; Dissipation factor (Df) < 0.004@10 GHz; Viscosity: 200-400 cp

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Development of Highly Reliable TGV Processes and Materials

Background

Highly reliable through-glass-via (TGV) interconnect structures represent a critical pathway for enhancing chip performance and functional integration, and are widely adopted in cutting-edge fields such as high-performance computing, artificial intelligence, and data centers. However, the coefficient of thermal expansion (CTE) mismatch between the glass substrate and the filled metal can lead to reliability risks such as substrate cracking and interconnection failure, hindering mass production. Therefore, improving the structural reliability of TGV-based glass carriers has become an urgent issue that demands resolution.

Research Objectives

- High-Adhesion Seed Layer Process and Equipment Technology
- Electroless Plating Process for Seed Layer Formation on Glass Carriers
- Sintering-Based TGV Seed Layer Deposition Materials and Processes
- High Aspect Ratio Stress-Adaptive/Buffer Layer Process Solutions
- Stress-Adaptive Copper Electroplating Technology

Key Specifications

- Seed Layer: Step coverage⩾5% (at 1μm feature size); Surface roughness⩽1nm (on bare glass substrate); Thickness via sintering⩽1μm; Thickness via electroless plating: 0.5–1μm
- Stress-Adaptive/Buffer Layer: Adhesion strength⩾5N/cm corresponding to TGVs aspect ratios of 20:1
- Internal Electroplated Copper Stress⩽50Mpa

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Development of Panel-Level Packaging Equipment

Background

The rapid development of high-performance chips for cloud computing, AI and other fields has put forward higher requirements for packaging. In response to the requirements for fine line widths and spacings and the demand for high-quality glass-based substrates, there is an urgent need for higher-precision lithography equipment to achieve fine line thinning of substrates, as well as more mature panel-level CMP equipment to efficiently remove copper from the substrate surface and flatten the interlayer medium.

Research Objectives

- Develop large-field, high-precision lithography equipment to address the demands of high-computing-power chips for highly integrated and large-format packaging substrates
- Develop panel-level CMP equipment to meet the requirements for surface copper removal and planarization of glass substrates; equipped with comprehensive functions including automated loading/unloading, fully automated programming, production system communication, and post-CMP cleaning

Key Specifications

- Lithography Equipment: Substrate size⩾510mm×515mm; Line width and spacing: L/S⩽2μm/2μm; Exposure field (FOV)⩾125mm×125mm; Critical dimension uniformity (CDU)⩽±10%; Compatible to various lithography materials including photoresist, dry film, and PSPI
- Panel-Level CMP Equipment: Capable of performing double-sided CMP on substrates (thickness⩾0.5 mm) with dimensions of 510mm×515mm or larger; Copper removal rate>1.5μm/min; ABF removal rate>5μm/min; Within-wafer non-uniformity (WIWNU): <10% (EE = 10mm); Dishing: <1μm (aperture <50μm)

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Development of High-Reliability MEMS Waterproof Encapsulation Materials and Processes

Background

Protected pressure sensors are widely used in various pressure measurement applications, including wearable devices, smart home systems, and intelligent gas meters. However, due to limitations in materials and processes, currently available protective encapsulation compounds often experience performance deviation after reflow soldering, which adversely affects product performance. It is crucial to study the material combinations and process conditions of MEMS waterproof packaging to enhance the reliability of protective pressure sensors in scenarios such as reflow and reliability testing.

Research Objectives

- Explore the MEMS waterproof encapsulation materials and process conditions, enhancing reliability under reflow and other critical reliability scenarios

Key Specifications

- No deformation of the encapsulation material and performance shift of the chip remain below 2% after three reflow cycles
- Product must pass Moisture Sensitivity Level 3 (MSL3) reliability testing: Step 1: Baking at 125°C for 24 hours. Step 2: Exposure to 30°C / 60% RH for 192 hours. Step 3: Execution of three reflow soldering cycles

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Highly Reliable TGV MEMS Pressure Sensor Chip

Background

The highly reliable TGV MEMS pressure sensor chip delivers exceptional performance, including high-temperature resistance up to 150°C, multi-liquid protection, and a wide pressure measurement range, making it suitable for a variety of industrial, automotive, and aerospace applications. However, structural integrity of the TGV MEMS pressure chip remains a critical challenge. It has been verified that chips fabricated using dry-process SOI technology under the same structural design exhibit significantly reduced mechanical strength. Addressing this issue through material and process optimization represents a key technological hurdle. It is a key issue to enhance the device strength through process improvements and develop a machine learning-based yield prediction methodology for MEMS chips to improve the reliability of pressure chips.

Research Objectives

- To specifically address current reliability issues such as TGV MEMS structural strength, thereby supporting leading performance in pressure sensor chips
- Based on existing process routes, central design values of chips, and practical process conditions, establish comprehensive monitoring indicators—including critical dimension (CD) measurement quantities and statistical tolerances for each process step—implement effective monitoring methods, and construct a robust TGV-MEMS process platform
- Leveraging TGV MEMS pressure chip technology, develop a complete set of high-precision, systematic yield prediction methodologies and models for mass production, facilitating continuous improvement in product yield and enabling expansion into diverse MEMS chip applications

Key Specifications

- Develop more than two machine learning models for yield prediction, including a dedicated model for TGV MEMS pressure sensor yield forecasting
- Achieve a prediction accuracy rate of ⩾80% for deep silicon etching depth
- Attain a yield prediction accuracy rate of ⩾70% for chips

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Development of High-Performance Smart Dimming Technology

Background

With the rapid development of the smart window market (e.g., smart dimming glass, automotive sunroofs, etc.), dye liquid crystal technology has become a key industry focus due to its advantages such as low power consumption, wide temperature range, and high contrast ratio. Currently, overcoming the performance bottlenecks of dye-based liquid crystal materials, developing high-contrast dye liquid crystal CP (normally black mode) solutions, and optimizing the thermal insulation performance of dye liquid crystal functional layers—thereby enabling intrinsic device-level insulation—are key to meeting the stringent application requirements in fields such as automotive and architectural glass.

Research Objectives

- Develop new high-contrast dye liquid crystal formulas and novel thermal insulation materials
- Develop a normally black cell configuration with high contrast ratio enhancement and thermal insulation characteristics to improve the performance of smart windows
- Complete the enhanced performance and reliability evaluation of functional layer of dye liquid crystals, ensuring their suitability for automotive or architectural applications

Key Specifications

- Cell thickness<12μm, compatible with mass-produced POL technology; Dark-state transmittance (Tr)<0.5%, bright-state transmittance (Tr)>20%; Contrast ratio (CR) >40
- The visible light transmittance (Tvis) of thermal insulation material>85%; Infrared transmittance (Tir)<5%@780-2500nm; Infrared reflectivity (R)>60%. After integrating the functional layer, the total transmittance (TTS)<15%
- Optimal bright state driving voltage<12V
- Sunlight irradiation Lifetime>1500h; Color Difference (ΔE)<2

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Glass-Based Hybrid Filter Solution

Background

The development of communication technology requires more frequency band support, leading to a sharp increase in the usage of filters at the RF front end. At the same time, the bandwidth requirement for some frequency bands has risen above 1000MHz. A single filtering technique cannot meet the requirements of large bandwidth, high roll-off, low insertion loss, and high out-of-band suppression simultaneously. Therefore, it is necessary to combine the excellent characteristics of different filters to explore hybrid filter schemes in order to address the challenges posed by next-generation communication technologies to filters.

Research Objectives

- Develop the glass-based hybrid filter integrated solution
- Design hybrid filter devices based on FBAR and glass-based IPD to meet the performance requirements for wide bandwidth and high roll-off, and output design specifications and process flow
- Complete the device fabrication. Analyze device performance influencing factors and propose optimization strategies based on measured data

Key Specifications

- Out-of-Band Rejection>35dB
- Bandwidth>500MHz
- Operating Frequency>5GHz

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Establishment and Development of Mechanical Waveform Library

Background

On rigid substrates, the achievable mechanical wave vibration modes need to be continuously enriched, and the driving signals and vibration modes can be designed.

Research Objectives

- Based on rigid substrates, the following content should be developed:
- Design and development of a mechanical waveform library
- Construction of a closed-loop feedback control system

Key Specifications

- Number of mechanical waveforms⩾30
- Distinguishable waveforms types⩾15
- Frequency range: 150Hz~250kHz
- Half wavelength of some high-frequency modes: 2~5 mm

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Photovoltaic Device

Defect Identification, Passivation and Mechanism of Industrialized PSCs

Background

Common defects in perovskite cells include vacancies, interstitials and grain boundaries, which limit the efficiency and stability. The academic methods used to identify these common defects include electron microscopy, PL/EL Mapping, ToF-SIMS, and TRPL. These methods can be used to identify defects in small devices, but their characterization methods are relatively complex and costly, and the testing process is time-consuming. Moreover, the test results are difficult to match with those of industrialized cells, making them unsuitable for the rapid and accurate identification of defects in perovskite cells. Thus, it is necessary to develop efficient defect identification technology to implement more precise passivation methods.

Research Objectives

- Development of rapid, accurate and sensitive defect identification technology
- Propose a passivation strategy and to guide at least one passivation case
- Establishment of a multi-dimensional passivation characterization system (carrier lifetime, defect density, stability test) for at least one passivation case

Key Specifications

PSCs (50*50mm):

- 8585 Test⩾T95@2000hr (PCE⩾24%)
- 85℃+ MPPT⩾T95@2000hr (PCE⩾24%)
- Thermal Cycling Test (200 cycles)⩾T95 (PCE⩾24%)
- UV⩾T95 @60kWh

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Research on the Efficiency and Stability of PSCs using Laser Processing and Encapsulation Techniques

Background

In the commercialization of perovskite solar cells, laser processing plays a key role in addressing efficiency and stability bottlenecks. Current optimization efforts primarily focus on reducing dead zones. However, in actual industrial applications, it has been observed that byproducts generated during laser processing can also affect the transport layers and photoactive layers. Therefore, it is essential to investigate the byproducts produced during laser scribing processes with different pulse widths and wavelengths, and their impact on device performance. Encapsulation technology, as a critical step for ensuring device stability, is typically performed under high-temperature and high-pressure conditions. Under these conditions, the evolution of transport and functional layer properties requires focused study. The findings are of great significance for guiding material selection, formulation, and process control of various functional layers.

Research Objectives

- Characterization of composition and valence state of the by-products in the laser process
- Laser by-products on the photoactive and functional layer, final on efficiency and stability
- Research on the encapsulation technology's influence on efficiency and stability

Key Specifications

- Linking PSCs degradation to by-products via comprehensive composition-valence-distribution
- Passivation technology and model establishment for laser-induced damage
- Identify the key factors causing the efficiency differences of PSCs in encapsulation process

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Research on the Key Factors Affecting the Lifespan and Efficiency of Flexible PSCs

Background

Flexible perovskite solar cells (f-PSCs), due to their outstanding photoelectric properties, lightweight and flexibility, as well as the low-cost solution-based fabrication advantages, have become a disruptive technology in the fields of wearable electronics, building-integrated photovoltaics (BIPV), and space energy. Over the past decade, their photoelectric conversion efficiency has soared from 3.8% to 27.32% (rigid< 0.1 cm^2) and 20.5% (flexible 25 cm^2), demonstrating great application potential. However, the stability bottleneck has severely restricted the industrialization process.

Research Objectives

- Research on dynamic transfer mechanism of residual strain under dynamic bending conditions
- Study the mechanism of interface defect and passivation under dynamic bending conditions
- Study the coupled failure of water-oxygen erosion and mechanical stress (>85% RH)
- Study the method to achieve cross-scale suppression of defects on large-scaled film

Key Specifications

f-PSCs (50*50mm):

- 8585⩾T90@2000hr (PCE⩾22%),
- 85℃+MPPT⩾T90@2000hr (PCE⩾22%)
- Thermal Cycling test (200 cycles)⩾T90 (PCE⩾22%),
- Bending 5000 times⩾T90 (bending radius⩽1cm)

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*Innovation Idea Call

Healthy Display Technology

Background

Display is now ubiquitous, following with the visual and non-visual health. Healthy display has become a research hotspot and market demand. The long-term evolution of humans to adapt to natural light is characterized by: (1) random distribution of vibration directions, with equal intensity of vibration in all directions; (2) Continuous and balanced spectral distribution (low blue light/rich red light), wide wavelength coverage, high color rendering index, and dynamic spectral changes that conform to natural rhythms; (3) Existing in forms such as diffusion/scattering/reflection, with uniform and soft light that rarely causes glare or intense light stimulation; (4) Continuous and stable light intensity output, extremely low fluctuation frequency (far beyond the perceivable range of the human eye), and brightness that adjusts adaptively according to the environment, seasons, day and night, etc. Based on years of in-depth research in the field of eye protection technology, BOE integrated multiple eye protection technologies including Circular Polarization, Low Blue Light, Depolarization, BLRL(BOE Low-Level Red Light), Infrared Light, Anti-Glare and Anti-Reflection, Flicker Free, and Light Self-adaptive to develop Beneficial Natural Light Technology (BNL). Furthermore, BOE is conducting multi-dimensional exploration of technologies related to healthy displays.

Objectives

Exploring technologies related to health display, including but not limited to the following:

- Establishing a human eye-sensitive spectral database: Quantifying the weight functions of each narrow-band light in the 380–780nm range on retinal photochemical hazards, circadian rhythm disturbances, and visual comfort. Proposing a health-oriented display spectrum optimization model and a "healthy spectrum" template library featuring low hazard, low rhythm disturbance, high color rendering index, and high energy efficiency
- Based on the characteristics of natural light (not limited to the four types of characteristics mentioned in the background introduction), proposing eye protection technologies that can be further integrated into the Beneficial Natural Light Technology (BNL), or other eye protection technologies beyond natural light
- Other health display technologies besides eye protection technologies (such as antibacterial and antiviral displays, etc.)

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Expanding the Applications of Flexible Piezoelectric Materials

Background

PVDF is an ideal flexible sensors fabricating material with high piezoelectric coefficient, excellent flexibility, broad frequency response, and high mechanical strength. It has been used in commercial ultrasonic fingerprint sensing systems successfully. In near future, PVDF holds significant potential for expanded applications in smart wearable, home automation, and health monitor systems.

Objectives

- Exploring viable hardware and software solutions to enable the expansion of flexible piezoelectric materials into new application areas. Examples include smart wristbands, mattresses, and seats for real-time monitoring of life signs such as heart rate, blood pressure, respiration, and sleep

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Stretchable Display Materials and Process Solutions

Background

Stretchable displays possess the ability to deform freely, enabling arbitrary shapes and conformal attachment. Additionally, stretchable displays can enhance the dimensionality of information presentation, offering greater possibilities for display applications. They are regarded as one of the mainstream trends in future deformable displays. Currently, high-resolution displays under large strain represent the technological development direction for stretchable displays, providing opportunities for richer display applications.

Objectives

- Stretch ratio⩾35%
- PPI⩾326
- Screen size⩾6 inches

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Innovative Application Solutions for High-Density Glass Substrate

Background

Driven by the explosive growth in artificial intelligence, high-performance computing, and data center demands, the issues of "power walls" and "speed walls" under high-bandwidth conditions have become increasingly prominent. Meanwhile, traditional distributed computing clusters face three major bottlenecks: data transmission latency, escalating power consumption, and insufficient bandwidth efficiency. In response, high-density packaging solutions based on glass substrates—leveraging their low loss characteristics, high-density interconnection capability, and excellent thermal stability—offer a promising pathway to address challenges related to high bandwidth, low power consumption, and high integration. Furthermore, glass wafer-level system packaging technology enables the integration of computing, memory, and I/O functions into a unified architecture, achieving a breakthrough that combines "cluster-scale computing power with chip-level efficiency".

Objectives

- Comprehensive High-Density Glass-Based Packaging Solution: High-speed optoelectronic co-design methodology, high-speed optical interconnect module design (including integrated solutions for modulators, detectors, and waveguides), and high-efficiency waveguide-to-fiber coupling strategy
- Design and process development of glass-based photonic interposers
- Glass Wafer-Level System-in-Package (SiP) Solution: Heterogeneous integration and multi-module interconnection design, along with system-level co-design and optimization
- Double-sided asymmetric wiring technology and wafer-level warpage control solution
- Innovative application solutions based on glass carrier substrates

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Development and Application Expansion of High-Performance Dye Materials

Background

With the advancement of display technologies toward higher resolution, lower energy consumption, and flexibility, functional dyes play a critical role in optical modulation, energy conversion, and emerging display solutions. However, current materials still face limitations in stability, transmittance, and functional expansion. It is therefore urgent to develop dye systems that combine high performance with multifunctionality to support innovative applications in next-generation display and optoelectronic products.

Objectives

- Achieve breakthroughs in key processes such as the synthesis, dispersion, and film coating of high-performance dyes, and establish material systems with superior optical properties, outstanding environmental stability, and expanded application potential

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Exploration of Innovative Applications of TFTs

Background

Glass-based TFTs feature low cost, capability for large-area fabrication at low temperatures, and high-density integration. They have already been widely applied in fields such as displays, high-precision sensing, X-ray detection, and microfluidics. Meanwhile, TFT applications are continuously expanding into emerging areas such as neural network computing and sensor-computation integration. In the future, with the advancement and transformation of various fields (e.g., artificial intelligence, communications, robotics, quantum computing, and healthcare), new demands will arise, and leveraging the inherent advantages of TFTs will enable the continuous emergence of innovative applications.

Objectives

- Propose potential application schemes for TFTs and expand their new application scenarios

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