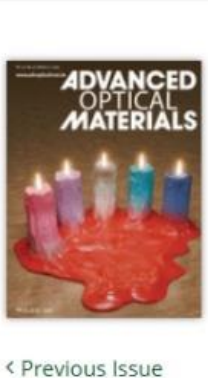

Advanced Optical Materials: Volume 13, Issue 9

March 21, 2025

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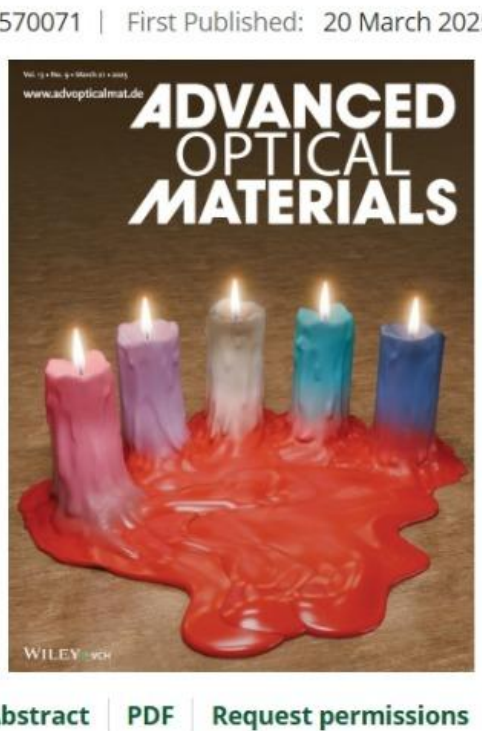
Cover Picture

Free Access

Ketocyanine-Based Materials for Near Infrared-to-Visible Thermochromism (Advanced Optical Materials 9/2025)

Alex Julià López, Noel Muñoz Pérez, Ruslan Mageramov, Mar Puyol, Ferran Crugeira, Sergey Miltsov, Daniel Ruiz-Molina, Claudio Roscini

2570071 | First Published: 20 March 2025



Thermochromism
The excellent solvatochromic and halochromic properties of ketocyanine dyes are exploited to obtain new wax-based multicolored thermochromic materials. By simply changing the phase-change-material and/or the color developer, solid mixtures of different colors are easily obtained, which all convert into the same color in the liquid state, when the dye does not interact with the environment. Such tunability gives also access to colorless-to-colored transition. More details can be found in article 2401411 by Daniel Ruiz-Molina, Claudio Roscini, and co-workers.

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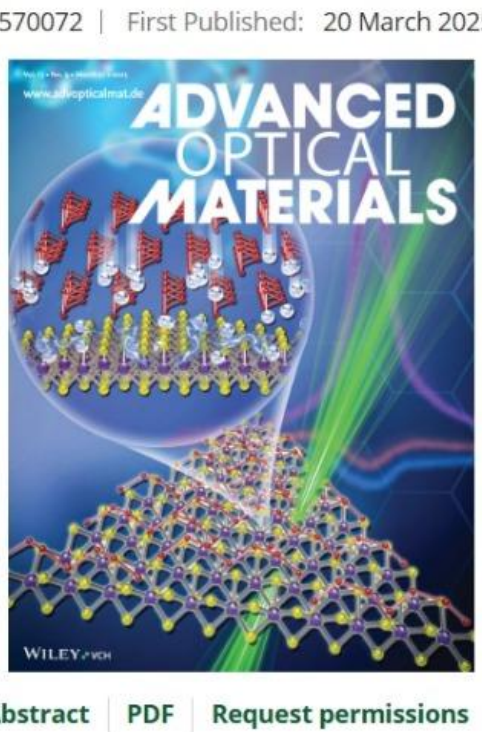
Inside Front Cover

Free Access

Controllable Synthesis of Se Microwires and Mixed-Dimensional Se/MoS_2 Vertical Heterostructures for Nonlinear Optical Applications (Advanced Optical Materials 9/2025)

Xinrui Ma, Kaiyi Wang, Chen Fan, Xuanbang Li, Yulong Hao, Jie Zhou, Xuemei Lu, Ting Shu, Lili Miao, Jin Li, Guolin Hao

2570072 | First Published: 20 March 2025



Nonlinear Optical Applications
In article 2402434, Lili Miao, Jin Li, Guolin Hao, and co-workers explore the effect of precursor concentration on the growth of selenium microwires and corresponding heterostructures. The effect of carrier transfer between the interfaces of t-Se/MoS_2 heterostructures on the enhancement of nonlinear optical properties is verified through experimental measurements and first-principles calculations.

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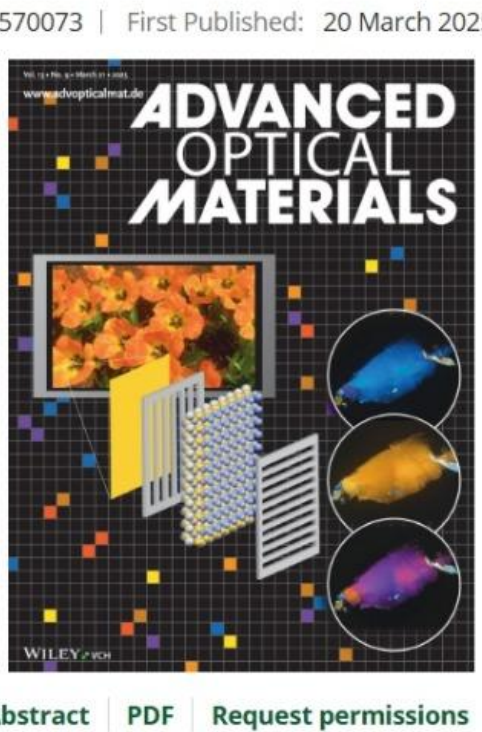
Back Cover

Free Access

Birefringent Color Filter by Layered Metal-Organic Chalcogenides: In-Plane Anisotropy and Odd/Even Effect (Advanced Optical Materials 9/2025)

Zichao Ye, Jie Zhao, Kisung Kang, Scott J. McCormack, Yu-Tsun Shao, Mikhail Y. Efremov, André Schleife, Waltraud M. Kriven, Jian-Min Zuo, Leslie H. Allen

2570073 | First Published: 20 March 2025



Organic-Inorganic Hybrid Composites
In article 2402159, Leslie H. Allen and co-workers reveal the birefringence in large single crystal silver alkanethiolate (AgSCn), as a result of in-plane structural anisotropy. The material is a promising candidate for pixels used in intelligent display. Therefore, the cover design starts with a screen display (with picture of flowers) and a single pixel is enlarged. In each pixel, an AgSCn crystal (the atomic structure cartoon) is sandwiched between two crossed polarizers. With such setup, the color of crystal (pictures taken on real samples on the right) exhibits dramatic change from blue to orange, and to purple simply by crystal rotation. A pixelated background was added to allude to the pixels in the display.

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2570074 | First Published: 20 March 2025

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Research Article

Open Access

Ketocyanine-Based Materials for Near Infrared-to-Visible Thermochromism

Alex Julià López, Noel Muñoz Pérez, Ruslan Mageramov, Mar Puyol, Ferran Crugeira, Sergey Miltsov, Daniel Ruiz-Molina, Claudio Roscini

2401411 | First Published: 29 November 2024

Fine-tunable thermochromic transition in the visible and near-infrared spectral regions. Simultaneous or selective activation of distinct intermolecular interaction mechanisms of Ketocyanine dyes with the external microenvironment (i.e. aggregachromism, solvatochromism, keto-enol equilibrium) gives straightforward access to several different thermochromic transitions (including colorless-to-colored), even from the same molecular dye.

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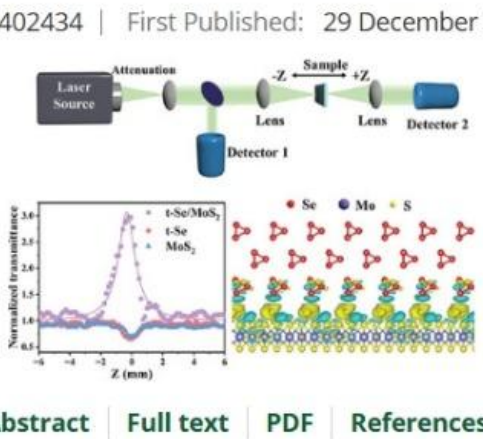
Controllable Synthesis of Se Microwires and Mixed-Dimensional Se/MoS_2 Vertical Heterostructures for Nonlinear Optical Applications

Xinrui Ma, Kaiyi Wang, Chen Fan, Xuanbang Li, Yulong Hao, Jie Zhou, Xuemei Lu, Ting Shu, Lili Miao, Jin Li, Guolin Hao

2402434 | First Published: 29 December 2024



Open-aperture Z-scan measurements tests for the t-Se/MoS_2 heterostructures show a significant enhancement of the nonlinear optical properties. Systematical experimental results combined with first-principles calculations further demonstrate that effective charge transfer between t-Se and MoS_2 interface is essential for the enhancement of nonlinear optical properties.

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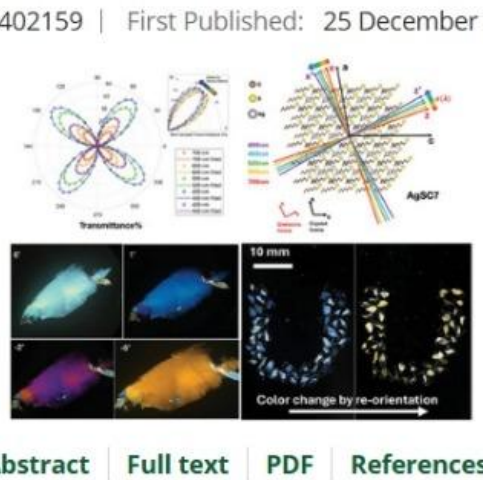
Birefringent Color Filter by Layered Metal-Organic Chalcogenides: In-Plane Anisotropy and Odd/Even Effect

Zichao Ye, Jie Zhao, Kisung Kang, Scott J. McCormack, Yu-Tsun Shao, Mikhail Y. Efremov, André Schleife, Waltraud M. Kriven, Jian-Min Zuo, Leslie H. Allen

2402159 | First Published: 25 December 2024



This study reveals the in-plane structural anisotropy and tunable in-plane birefringence for large single crystal silver alkanethiolate (AgSCn) with ligands of variable length/parity. The rotation of its dielectric frames triggers its color change with different crystal orientations under crossed polarizers, inspiring an emerging pathway for color filtering used in intelligent display.

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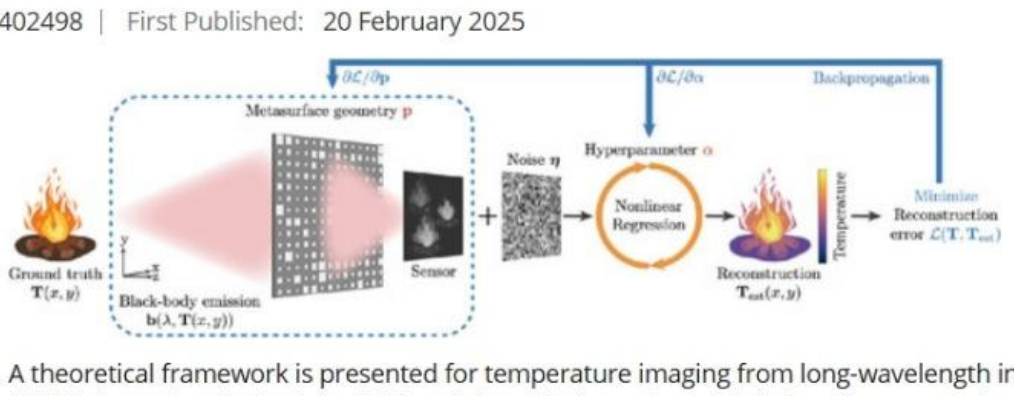
End-to-End Metasurface Design for Temperature Imaging via Broadband Planck-Radiation Regression

Sophie Fisher, Gaurav Arya, Arka Majumdar, Zin Lin, Steven G. Johnson

2402498 | First Published: 20 February 2025



A theoretical framework is presented for temperature imaging from long-wavelength infrared (LWIR) thermal radiation (e.g., 8-12 µm) through the end-to-end design of a metasurface-optics frontend and a computational-reconstruction backend. A new nonlinear reconstruction algorithm, "Planck regression", is introduced to reconstruct the temperature map from a gray scale sensor image, even in the presence of severe chromatic aberration, by exploiting black body and optical physics particular to thermal imaging. This algorithm is combined with an end-to-end approach that optimizes manufacturable, single-layer metasurfaces to yield the most accurate reconstruction.

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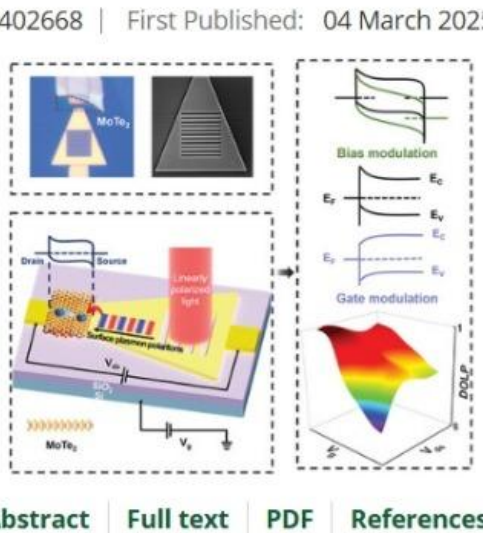
On-Chip Metasurface-Mediated $MoTe_2$ Photodetector with Electrically Tunable Polarization-Sensitivity

Ruizhi Li, Xinlei Zhang, Fan Zhong, Yuanfang Yu, Peidong Yan, Dangyuan Lei, Junpeng Lu, Zhenhua Ni

2402668 | First Published: 04 March 2025



This study presents a hybrid electrically tunable photodetector that integrates 2D $MoTe_2$ with gold metasurface for near-infrared polarization detection. By utilizing contact engineering and electro-tuning techniques, the device realizes highly tunable Schottky barriers, allowing for continuous adjustment of the degree of linear polarization from 0.2 to an ultimate value of 1.0.

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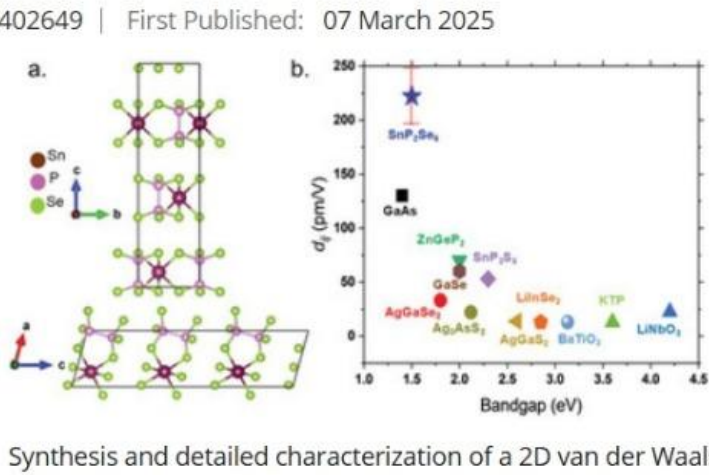
Large Non-Resonant Infrared Optical Second Harmonic Generation in Bulk Crystals of Van der Waals Semiconductor, SnP_2Se_6

Jadupati Nag, Saugata Sarker, Safdar Imam, Abishek Iyer, Michael J. Waters, Albert Suceava, James M. Rondinelli, Mercouri G. Kanatzidis, Venkatraman Gopalan

2402649 | First Published: 07 March 2025



Synthesis and detailed characterization of a 2D van der Waals semiconductor SnP_2Se_6 are reported along with a thorough investigation of its linear and optical second harmonic generation (SHG) properties. With an exceptionally high non-resonant SHG coefficient (d_{33} = −222 ± 30 pm V^{-1} at a 2 µm fundamental wavelength, which is ≈ 7 times larger than that of the commercial $AgGaSe_2$ with comparable bandgap), phase-matching capabilities, and large laser damage threshold, SnP_2Se_6 stands out as a promising material for infrared frequency conversion applications.

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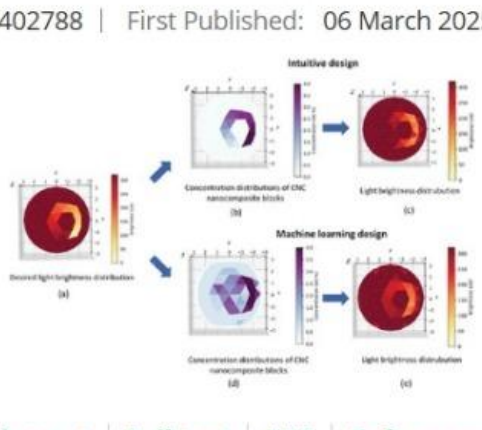
Machine Learning Enabled LED Lighting Using Scattering Optics

Gangyi Li, Yuan Liu, Hao Liang, Xihua Wang

2402788 | First Published: 06 March 2025



The light spatial distribution (brightness pattern) of a white LED is usually controlled by specially designed lenses and mirrors but not demonstrated using scattering optics (e.g., optical diffusers). It is generally believed that lack of control in transferring light in space makes optical diffusers impossible to focus light onto desired directions. Here scattering optics for LED lighting is applied and achieved desired brightness patterns using customized optical diffusers and machine learning design.

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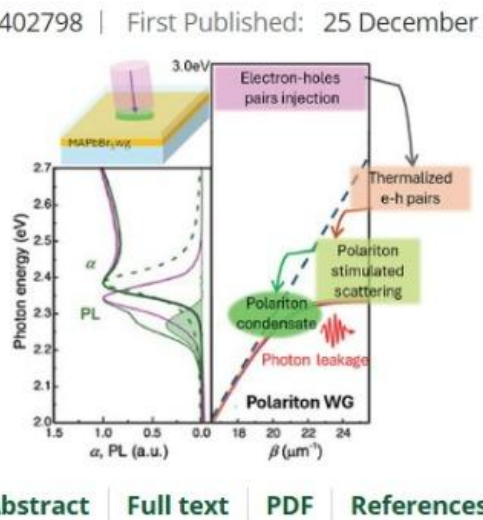
Single-Threshold Amplified Spontaneous Emission in the Absence of Photon Gain in $MAPbBr_3$ Planar Waveguides

Angelica Simbula, Federico Pitzalis, Riccardo Pau, Emanuele D. Cadeddu, Luyan Wu, Stefano Lai, Fang Liu, Selene Matta, Valeria Demontis, Daniela Marongiu, Paolo Pintus, Francesco Quochi, Michele Saba, Andrea Mura, Giovanni Bongiovanni

2402798 | First Published: 25 December 2024



Femtosecond tandem spectroscopy of $MAPbBr_3$ planar waveguides allows measuring the absorption, gain and photoluminescence spectrograms, revealing the microscopic mechanisms that trigger amplified spontaneous emission (ASE). Results show that ASE always involves hybrid light-matter excitations at all measured excitations, in the absence of photon gain, a characteristic almost unique in photonic materials.

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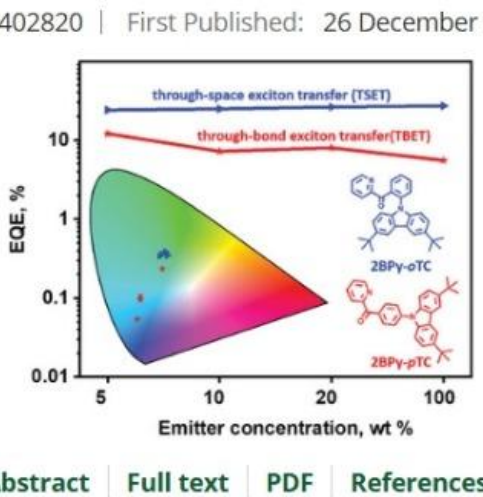
Regulating Spatial Configuration in Donor-π-Acceptor for through-Space Exciton Transfer: Concentration-Independent Emitter for OLEDs

Nisha Yadav, Upasana Deori, Arun K Manna, Pachaiyappan Rajamalli

2402820 | First Published: 26 December 2024



Herein, two positional isomers, 2BPy-*p*TC and 2BPy-*o*TC, are designed and synthesized by carefully balancing the ratio of through-bond exciton transfer and through-space exciton transfer. 2BPy-*o*TC facilitates the π-electron cloud interactions through space and mitigates intermolecular interactions. Hence, 2BPy-*o*TC acts as a universal emitter, retaining identical EQE_{max} and emission maxima, regardless of concentration.

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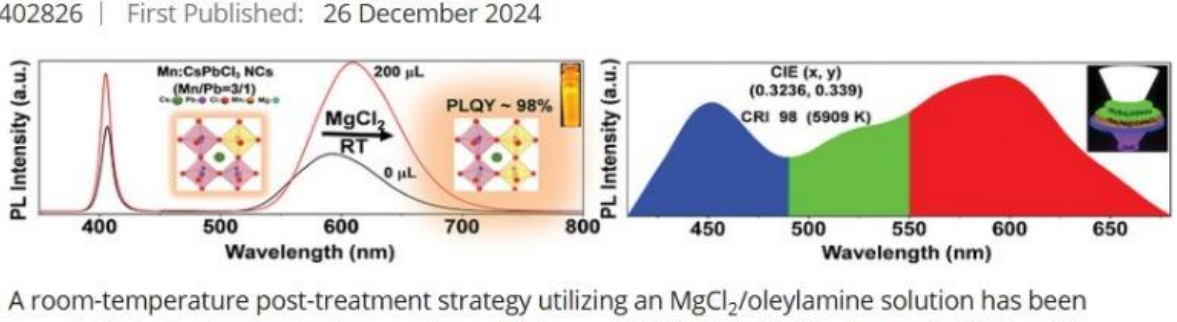
Unlocking Near 100% PLQY: The Impact of Post-Treatment on Emission Efficiency of Mn^{2+}: $CsPbCl_3$ Nanocrystals

Liling Fei, Lin Yang, Peng Li, Jiangang Ma

2402826 | First Published: 26 December 2024



A room-temperature post-treatment strategy utilizing an $MgCl_2$/oleylamine solution has been reported, aiming to elevate the quantum efficiency of Mn^{2+}:$CsPbCl_3$ NCs to nearly 100%, while simultaneously enhancing their stability and Mn^{2+} ions doping efficiency, as well as passivating intrinsic defects.

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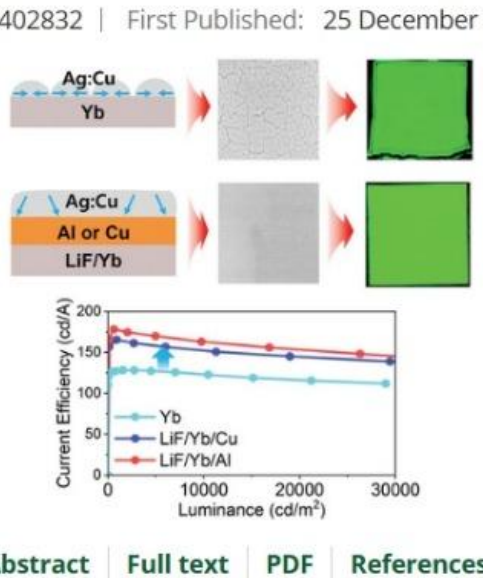
Addressing Thermal Stability Challenges in Top-Emission OLEDs: The Role of Buffer Layer in Preventing Pixel Shrinkage

Seung Ju Ok, Thi Na Le, Ji Hee Son, Seung Yong Song, Min Chul Suh

2402832 | First Published: 25 December 2024



A strategic approach to improve the thermal stability and efficiency of top-emission OLEDs by incorporating a high-energy buffer layer (Cu or Al), a bilayer electron injection layer (LiF/Yb), and a low-sheet resistance Ag:Cu cathode. This design ensures superior cathode morphology, achieving 178 cd A^{-1} efficiency and exceptional thermal stability without pixel shrinkage under prolonged high-temperature conditions.

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Editor's Choice

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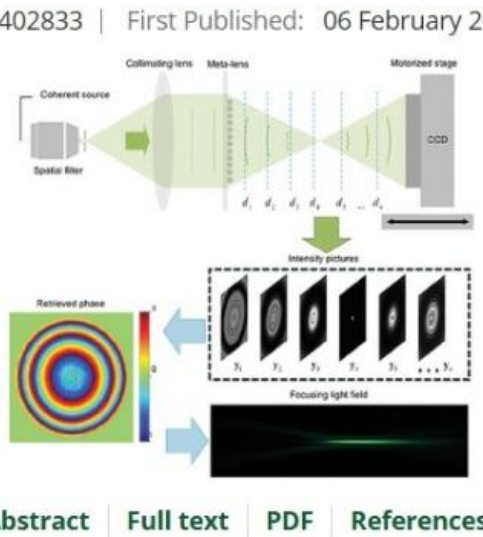
Quantitative Phase Imaging for Meta-Lenses by Phase Retrieval

Jialuo Cheng, Yin Zhou, Yunhui Gao, Bowen Liu, Xiaoyuan Liu, Lei Shi, Zihan Geng, Mu Ku Chen

2402833 | First Published: 06 February 2025



A novel methodology is proposed for meta-lenses phase recovery utilizing five defocused images. With the retrieved phase distribution, this approach enables the retrieval of the focused light field at arbitrary distances, faster than general light field scanning methods. Notably, this method does not require complex experimental setups and demonstrates robustness and applicability across meta-lenses with diverse phase modulations.

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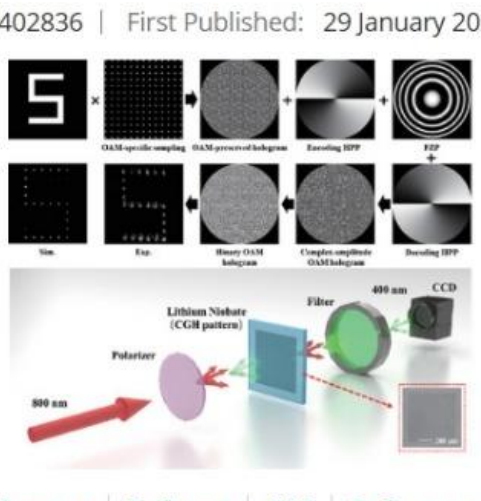
3D Orbital Angular Momentum Nonlinear Holography

Feiyang Shen, Weiwen Fan, Yong Zhang, Xianfeng Chen, Yuping Chen

2402836 | First Published: 29 January 2025



This work proposes 3D orbital angular momentum nonlinear holography, enabling flexible projection of different OAM channels onto distinct imaging planes. The holograms are fabricated on the surface of birefringence lithium niobate crystals using femtosecond laser micromachining, achieving a more compact and integrated approach for low-crosstalk, high-longitudinal-resolution 3D multi-plane holographic imaging.

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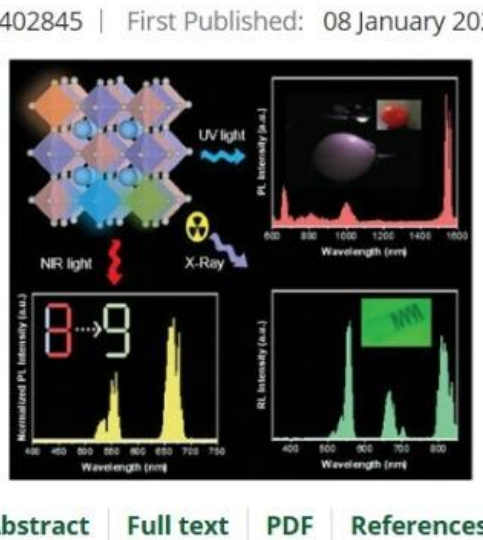
Tailoring the Emission Properties of $Cs_2NaLuCl_6$ for Anti-Counterfeiting, X-Ray Scintillation, and Night Vision Applications

Xiu-Xian Guo, Zi-Lin He, Jing-Hua Chen, Jian-Bin Luo, Jun-Hua Wei, Qing-Peng Peng, Dai-Bin Kuang

2402845 | First Published: 08 January 2025



The Sb^{3+}-Ln^{3+}-codoped $Cs_2NaLuCl_6$ single crystals with tunable emissions are prepared. Leveraging the excitation-dependent emission behavior, NIR emission, and excellent X-ray scintillation performance, the ion-doped $Cs_2NaLuCl_6$ can be employed as anti-counterfeiting, night-vision, and X-ray imaging material.

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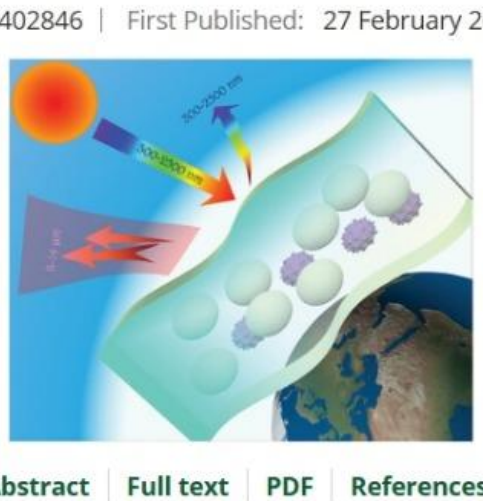
Hierarchical Microspheres-Based Composite Materials with TiO_2-Coated SiO_2 Combined with $BaSO_4$ or PNIPAM for Radiative Cooling

Jiefeng Li, Ming Fu, Heling Zhang, Chenhui Wei, Dawei He, Yongsheng Wang

2402846 | First Published: 27 February 2025



Composites consisting of SiO_2, TiO_2-coated SiO_2, $BaSO_4$ hierarchical microspheres, or PNIPAM spheres are fabricated using a microfluidic method. These composites exhibit excellent infrared emissivity across the atmospheric transparency window, while the different components of the hierarchical microspheres provide structural colors, high visible light reflectivity, or temperature-responsive transmissivity.

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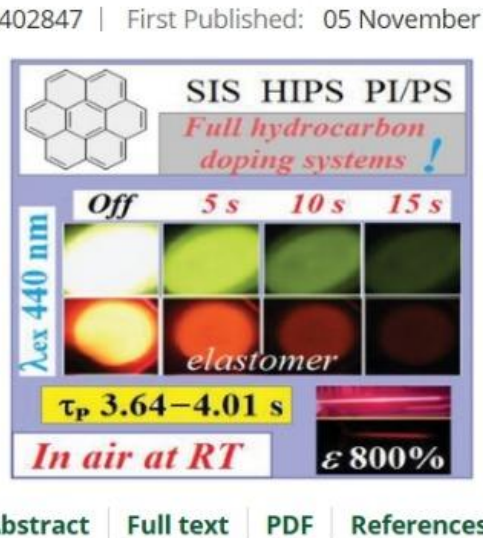
Highly Elastic Full Hydrocarbon Ultralong RTP Polymers with Visible Light Excitable S_0→T_1 Population

Guanyu Liu, Shiguo Zhang, Junwu Chen, Shanfeng Xue, Qikun Sun, Wenjun Yang

2402847 | First Published: 05 November 2024



Full hydrocarbon room temperature phosphorescence (RTP) systems show the brightest, longest RTP elastomers/plastics in air, and after glow duration is tens of seconds. These doped systems exhibit visible light excitable and naked eye visible RTP afterglow in spite of no absorption band. They have unique driving triplet population factors rather than the usual spin-orbital coupling (SOC) mechanism.

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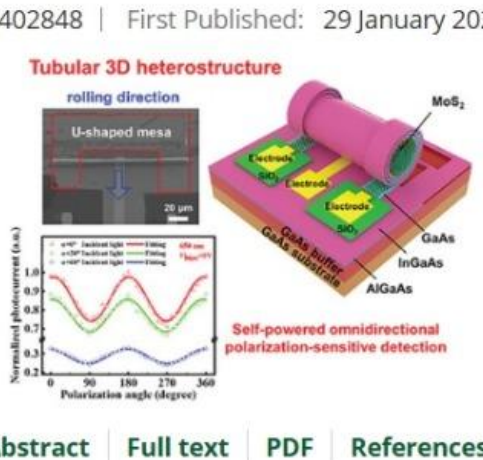
Self-Powered Polarization-Sensitive 3D Photodetector with Fast Response Enabled by Mechanically-Guided Assembly of Tubular MoS_2/GaAs/InGaAs Heterostructure

Mingyang Shen, Qi Wang, Hao Liu, Han Ye, Xueguang Yuan, Yangan Zhang, Bo Wei, Xue He, Kai Liu, Shiwei Cai, Yongqing Huang, Xiaomin Ren

2402848 | First Published: 29 January 2025


Tubular 3D heterostructure
rolling direction
U-shaped mesa
MoS_2
Electrode
GaAs
InGaAs
AlGaAs
Self-powered omnidirectional polarization-sensitive detection
Polarization angle (degree)

3D photodetector (3dPD) based on heterostructure is successfully fabricated and achieves self-powered omnidirectional polarization-sensitive photodetection with fast response, via the controllable rolling assembly and crafted electrode design of tubular MoS_2/GaAs/InGaAs heterostructure. The study highlights the prospect of heterostructure-based tubular 3dPDs in low-power consumption, fast target recognition, and tracking.

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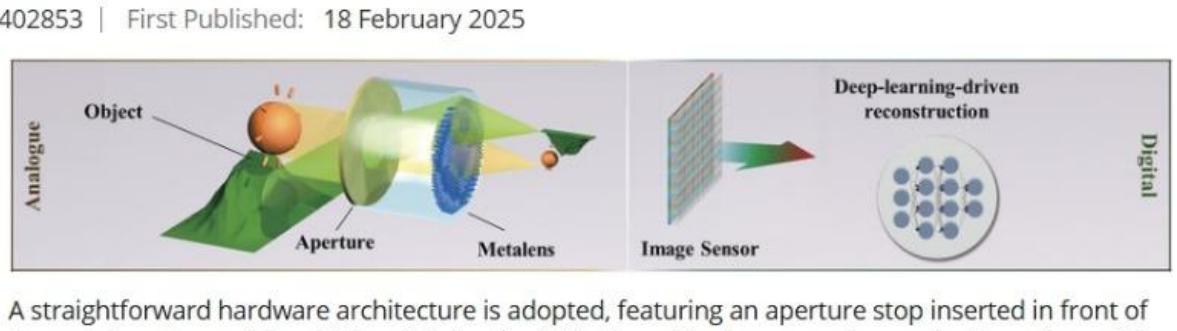
End-to-End Optimization of Metalens for Broadband and Wide-Angle Imaging

Yeongmyeong Park, Youngjin Kim, Changhyun Kim, Gun-Yeal Lee, Hyeongyu Choi, Taewon Choi, Yoonchan Jeong, Byoungho Lee

2402853 | First Published: 18 February 2025



A straightforward hardware architecture is adopted, featuring an aperture stop inserted in front of the metalens to provide additional design flexibility for mitigating monochromatic aberrations. This enables high signal-to-noise ratio measurements and reduces the load on the reconstruction network. Additionally, an end-to-end optimization framework is employed to achieve a 70° field-of-view for full-color imaging across the visible spectrum.

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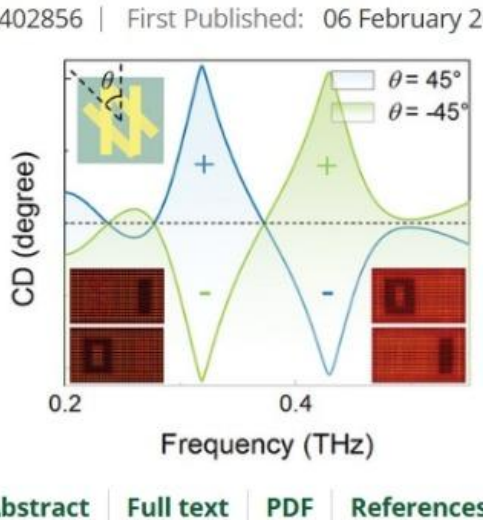
Dual-Band Quasi-Bound States in the Continuum with Opposite Circular Dichroism Supported by Single Metallic Bilayer Twisted Metasurface

Jixin Feng, Xianghui Wang, Ming Zeng, Linyuan Fan, Liang Ma, Yunyun Ji, Fei Fan, Shengjiang Chang

2402856 | First Published: 06 February 2025



By manipulating a single degree of freedom, the twist angle, a metallic double-layer twisted metasurface is proposed to simultaneously induce QBIC and chirality at different frequency bands. Remarkably, the structure exhibits opposite chiral responses at two frequency bands. A dynamic near-field image display switched by frequency or polarization state is demonstrated to highlight this device's superiority.

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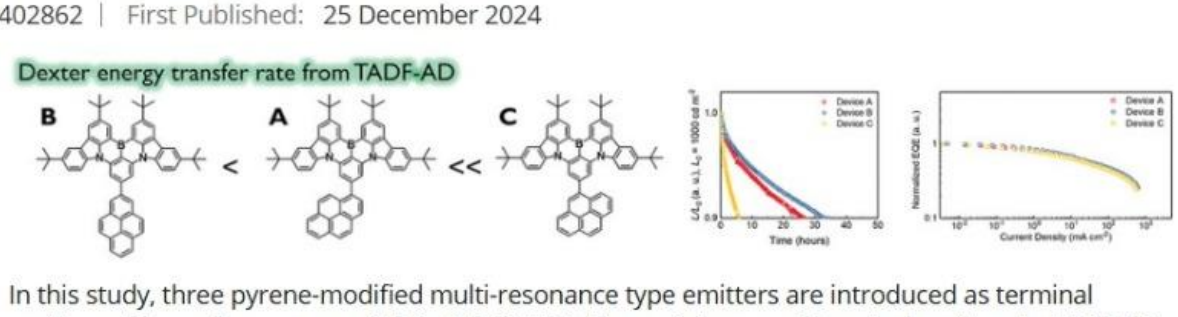
Regioisomer Effect of Pyrene on Multi-Resonance Emitters and Their Application for Hyperfluorescence Organic Light-Emitting Diodes

Chanhee Lee, Yi-Ting Lee, Chin-Yiu Chan, Chae Won Park, Sanghyun Lee, Hye In Kwon, Dahee Boo, Youichi Tsuchiya, Sae Youn Lee, Chihaya Adachi

2402862 | First Published: 25 December 2024


Dexter energy transfer rate from TADF-AD
B
<
A
<<
C
Device A
Device B
Device C
Time (hours)
Current Density (mA cm⁻²)

In this study, three pyrene-modified multi-resonance type emitters are introduced as terminal emitters of hyperfluorescence OLEDs (HF-OLEDs). The regioisomer of terminal emitters in HF-OLEDs provided a different Dexter energy transfer rate. It provided significant difference in the device lifetimes, even the device performances exhibited no difference between those three emitters.

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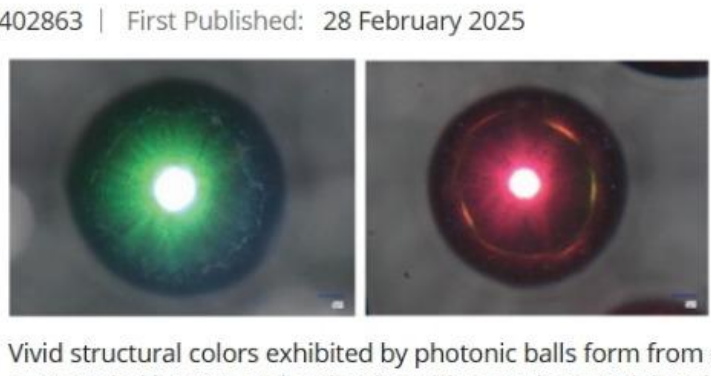
Brilliant and Angular-Independent Photonic Balls Using High-Refractive-Index Inorganic-Polymer Hybrid Materials

Yangnan Jiang, Ayano Shirai, Michinari Kohri, Ryosuke Ohnuki, Shinya Yoshioka, Tetsuya Yamamoto, Yukikazu Takeoka

2402863 | First Published: 28 February 2025



Vivid structural colors exhibited by photonic balls form from monodisperse cerium oxide particles surrounded by PDA and carbonize with organic material under a nitrogen stream.

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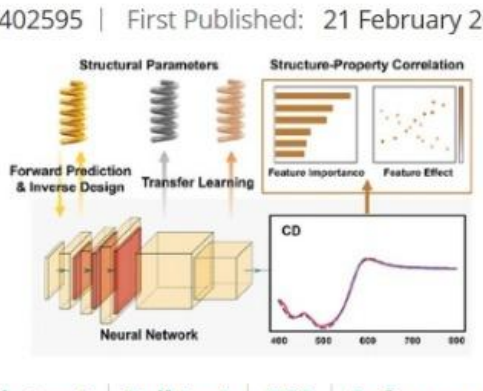
Machine Learned Structure-Property Correlation Between Nanohelices and Circular Dichroism

Juanshu Wu, Yingming Pu, Jin Wang, Bing Gu, Xin Chen, Hongyu Chen

2402595 | First Published: 21 February 2025



A data-driven, interpretable neural network model is developed for rapid, accurate prediction of helical structure CD spectra and generation of nanohelices with specific optical properties. The interpretability analysis of the model uncovers quantitative correlations between the physical structures of nanohelices, their chiral strength, and variations in their CD spectra.

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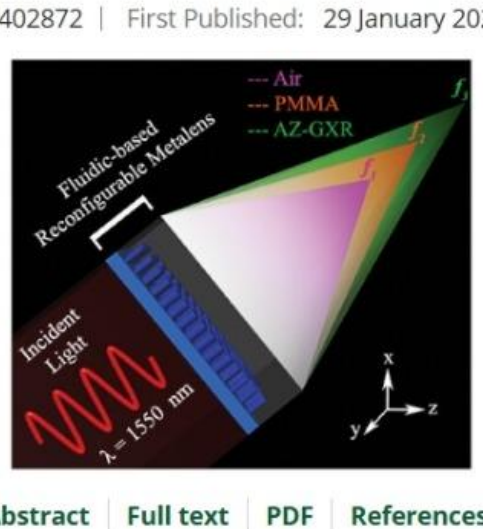
Fluid-Induced Reconfigurable Polarization-Insensitive Metasurfaces for Optical Wireless Communications

Ramna Khalid, Jaekyung Kim, Nasir Mahmood, Alessia Candeo, Abdul Rahman, Muhammad Qasim Mehmood, Muhammad Zubair, Zoltán Bozóki, Junsuk Rho

2402872 | First Published: 29 January 2025



This research presents a fluid-induced reconfigurable polarization-insensitive metasurface designed to enhance optical wireless communication (OWC) systems. This ultra-thin silicon metasurface adjusts the focal length of infrared light by utilizing immersed fluids, precisely targeting users while ensuring consistent signal quality and improves data transmission without being affected by the polarization of the incident light.

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Multiple Donor Modification of Boron-Based Emitters to Produce Aggregation-Induced Emission and Thermally Activated Delayed Fluorescence for Blue OLEDs

Mohan Gandhi Devulapally, Yeonju Jeong, Jae Hee Lee, Min Jeong Kwon, Sunwoo Kang, Taekyung Kim, Wan Pyo Hong

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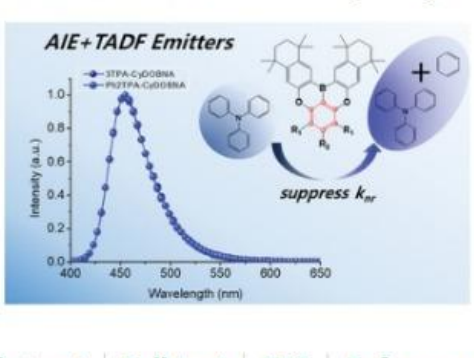

This study introduces two novel multi-donor emitters based on 1,1,4,4,12,12,15,15-octamethyl-1,2,3,4,12,13,14,15-octahydro-6,10-dioxa-16*b*-boraanthra[3,2,1-*de*]tetracene (CyDOBNA), designed to enhance thermally activated delayed fluorescence (TADF) and aggregation-induced emission (AIE) properties. Of the two, Ph2TPA-CyDOBNA suppressed non-radiative pathways and achieved an improved external quantum efficiency (EQE) of 21.1%.

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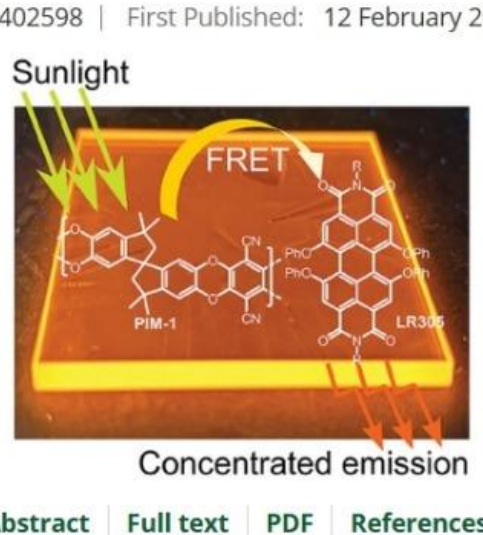
Polymer of Intrinsic Microporosity as Light Absorber for Luminescent Solar Concentrators

Yuxing Wang, Meihuizi Jiang, Saif A. Haque, Sebastien Rochat

2402598 | First Published: 12 February 2025



The first use of a polymer of intrinsic microporosity (PIM-1) is demonstrated as a light absorber in a luminescent solar concentrator (LSC). Combined with a red dye emitter, PIM-1 acts as an antenna and efficiently transfers energy to the emitter via Förster Resonance Energy Transfer (FRET). The resulting LSC possesses promising efficiency metrics, opening new avenues for the use of PIMs in light harvesting applications.

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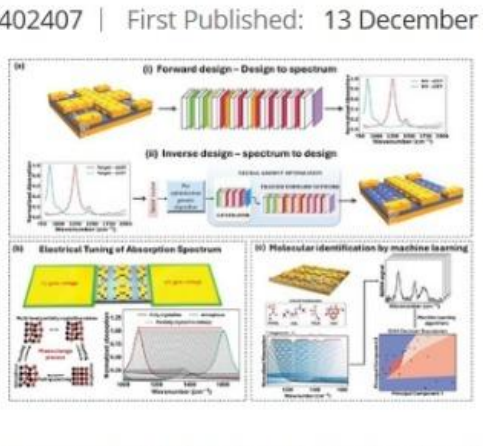
AI-Enabled Inverse Design and Molecular Identification Using Phase Change Metamaterial Absorber

Ram Prakash S, Aastha Jain, Rajesh kumar, Anirban Mitra

2402407 | First Published: 13 December 2024


(i) Forward design – Design to spectrum
(ii) Inverse design – spectrum to design
Electrical Tuning of Absorption Spectrum
Molecular identification by machine learning

AI-enabled inverse design of phase change metamaterial design and molecular identification using SEIRA and machine learning techniques. Phase change metamaterial absorber is inversely designed for the desired absorption spectrum in the MIR region using a Wasserstein Generative Adversarial Neural Network-based free-form inverse design strategy. Tunability in the absorption spectrum is achieved by the application of voltage pulses through the microheater integrated with an inversely designed phase change metamaterial absorber. Using the inverse-designed phase change metamaterial absorber, the molecular vibrational fingerprints are retrieved, and the molecules are identified using a machine learning model with 100% accuracy.

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Lossless Phase Change Materials for Adjustable Tamm Plasmon Polaritons in the Near-Infrared

Ming-Jyun Ye, Rashid G. Bikbaev, Pavel S. Pankin, Lu-Hsing Chen, David Chiu, Ivan V. Timofeev, Hung-Wen Chen, Satoshi Ishii, Kuo-Ping Chen

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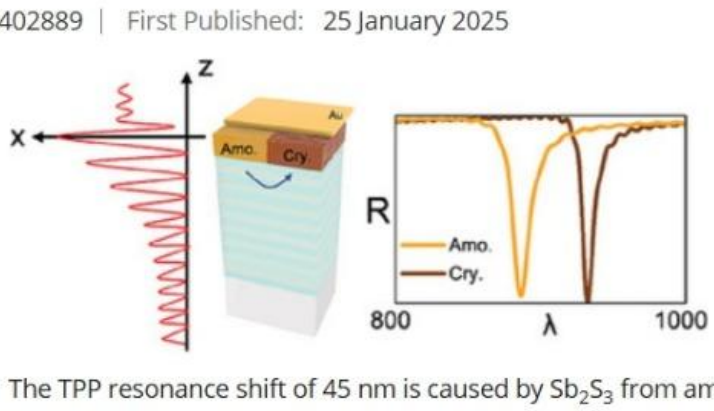

The TPP resonance shift of 45 nm is caused by Sb_2S_3 from amorphous to crystalline. Also, the angle-dependent resonance shifts of 85 nm, 76 nm, and 63 nm are achieved by unpolarized, TM mode, and TE mode NIR light, respectively.

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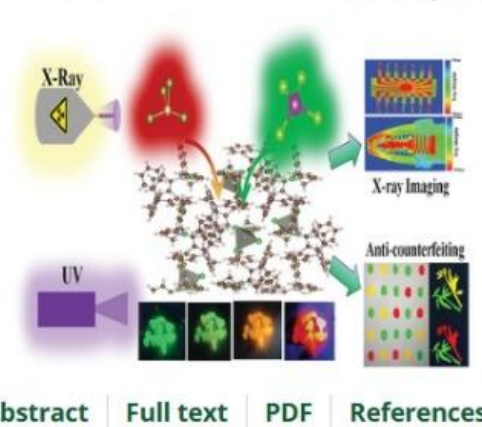
Efficient Multicolor Emission Zn-Sb-Mn Chloride Scintillators: Large-Scale Production for Multi-Level Anti-Counterfeiting, Information Storage, and X-Ray Imaging

Tao Huang, Tongzhou Li, WenChao Lin, Jinyu Lei, Weijian Li, Quan Niu, Bingsuo Zou

2402890 | First Published: 24 January 2025



By doping Sb^{3+} and Mn^{2+} into Zn/Cd-based halides with tetrahedral clusters, several scintillating materials with highly efficient emissions in various colors have been obtained. Notably, Ph_3M-Zn:Sb^{3+}@Mn^{2+} out of the above compounds exhibits PLQY values exceeding 90% for all three color emissions. Furthermore, it demonstrates exceptional scintillation performance under X-ray illumination, surpassing most commercial scintillators.

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Layer-By-Layer Shear-Printing of Bulk Mechanoresponsive Photonic Crystals

Feng Gao, Junjun Qiu, Xinyu Jiang, Tong An, Xiaokun Song, Manyao Zhang, Nan Shi, Wei Yu, Tongxiang Fan, Qibin Zhao

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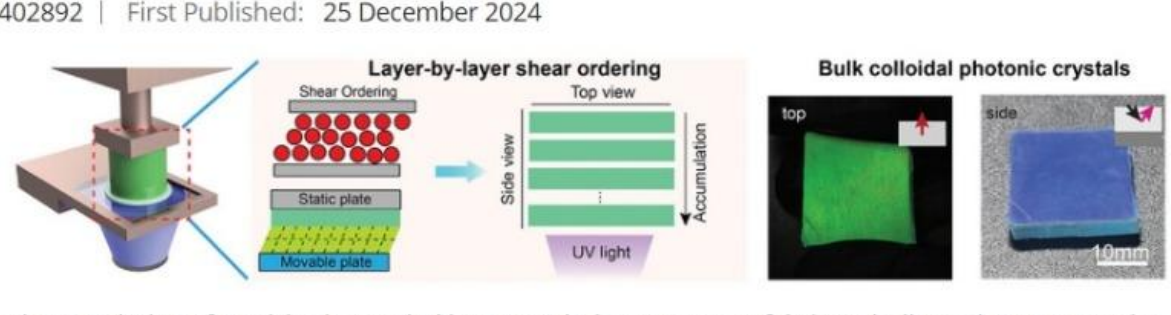

Shear-ordering of particles is coupled into 3D printing process to fabricate bulk mechanoresponsive photonic crystals with bright, saturated structural colors and 80% reflectance. These materials exhibit exceptional strain resilience and pronounced color shifts under stress. This efficient method achieves optical performance comparable to leading thin films and allows for the creation of complex shapes, expanding the potential applications of mechanoresponsive photonic crystals.

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