

Junseok (Justin) Ma, Ph.D.

Staff Engineer · Advanced Antenna Lab, Samsung Electronics

Liquid-crystal reconfigurable devices · RF / mmWave wave control ·
Printed optoelectronics

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RESEARCH PROFILE

I develop liquid-crystal (LC) devices that control light and RF waves by engineering material states, alignment and fabrication. My work spans printed optical-memory pixels, smart windows, tunable RF components and reconfigurable RF surfaces. My future research will co-design LC composition, alignment and electrical driving to address trade-offs among operating voltage, switching dynamics and device performance. I aim to progressively integrate automated fabrication and measurement with data-driven experimental design, to establish experimentally validated design principles for energy-efficient reconfigurable photonic and RF hardware.

- First or co-first author of 8 journal articles, including *Advanced Materials* (Frontispiece Cover), *Advanced Optical Materials* (Hot Topic), *ACS Applied Materials & Interfaces* and *Advanced Materials Technologies*; 2 further first- or co-first-author manuscripts are under review.
- 23 international journal articles and 1 Korean-society journal article, with 4 more submitted or under review; 208 citations, h-index 7 (Google Scholar, Oct 24, 2026).
- Kim Beom-Man Best Ph.D. Dissertation Award (POSTECH); Jang Young-Sil Postdoctoral Fellowship (KAIST/NRF); BK21 FOUR Outstanding Graduate Student Award for Overseas Research, one of 14 recipients nationwide (2025).

SELECTED RESEARCH HIGHLIGHTS

ADVANCED MATERIALS TECHNOLOGIES · 2026

Coating-free LC alignment on PCB mmWave unit cells

Replaced polymer alignment layers on PCB substrates with coating- and baking-free nanoscratching, enabling $\sim 250^\circ$ measured reflection-phase tuning at 28 GHz.

First author (equal contribution) · KAIST

ACS APPLIED MATERIALS & INTERFACES · 2026

Inkjet-printed cholesteric LC pixels with optical memory

Converted the frequency-dependent response of cholesteric LCs into a pixel function: 63.5-dpi printed pixels with frequency-addressable optical memory.

Co-first (equal contribution) & corresponding author

ADVANCED OPTICAL MATERIALS · 2025

HOT TOPIC

Printed electrochromic PDLC smart windows

Combined electrochromic PDLC droplets with drop-on-demand printing for simultaneous control of color, transmittance and spatial image integration.

First author · Oxford-POSTECH

ADVANCED MATERIALS · 2023

FRONTISPIECE COVER

Review: LC devices for microwave and mmWave communications

Systematic review of LC materials and reconfigurable devices for microwave and mmWave communications.

First author · 78 citations

EDUCATION

- Feb 2022 – Aug 2025 ○ **Ph.D. in Electrical Engineering**
POSTECH · Pohang, Republic of Korea
Advisor: Prof. Wook-Sung Kim.
- Dissertation: Development of Multifunctional Reconfigurable Liquid Crystal Devices Using Drop-on-Demand Printing
 - Kim Beom-Man Best Ph.D. Dissertation Award (highest doctoral dissertation award of the Department of Electrical Engineering), 2026
- Feb 2020 – Feb 2022 ○ **M.S. in Electrical Engineering**
POSTECH · Pohang, Republic of Korea
- Thesis: A Study of Liquid Crystal-Based Phase Shifter in the Millimeter-Wave Range for Utilizing Current Mass-Production Technology of the Display Industry
- Feb 2016 – Feb 2020 ○ **B.S. in Electrical Engineering**
POSTECH · Pohang, Republic of Korea
Full scholarship for 4 years; Kim Jong-Han Foundation Scholarship (2018–2019); Vice-President (Residential College Advisor) and Best Advisor Award (2018–2019).

PROFESSIONAL & RESEARCH EXPERIENCE

- Sep 2026 – Present ○ **Staff Engineer, RF/Antenna Engineering, Advanced Antenna Lab, Mobile eXperience Division**
Samsung Electronics, Suwon
- Advanced antenna research for mobile and emerging devices, in a lab working on AI-driven antenna design.
- Sep 2025 – Aug 2026 ○ **Jang Young-Sil Postdoctoral Research Fellow**
Natural Sciences Research Institute and Soft Material Assembly Group (Prof. Dong Ki Yoon), KAIST
- Developed a coating-free nanoscratching process for LC alignment on PCB-compatible mmWave reflective unit cells, with ~250° measured reflection-phase tuning at 28 GHz (*Adv. Mater. Technol.*, 2026; first author, equal contribution).
 - Studied how matched and mismatched chiral twist affects the phase-tuning and switching characteristics of a 160-GHz LC-RIS (*IEEE Access*, submitted; co-first author).
 - Developed electrically translated, subpixel-free color generation in LC heterostructures (*Laser & Photonics Reviews*, submitted; first and corresponding author); contributed to national R&D programs on LC-enabled RIS and mmWave beamforming antennas.
- Dec 2023 – Dec 2024 ○ **Recognised Student (Visiting Researcher)**
Soft Matter Photonics Group, Department of Engineering Science (Prof. Stephen M. Morris, Prof. Steve J. Elston), University of Oxford
- Developed drop-on-demand printed electrochromic PDLC smart windows with simultaneous control of color and transmittance and spatial image integration (*Advanced Optical Materials*, 2025, Hot Topic; first author).
 - Co-authored collaborative studies on printed LC beam-shaping droplets (*Adv. Funct. Mater.*, 2026) and a printed, optically transparent LC antenna (*Adv. Mater. Sci. Eng.*, 2026).

Wave Arrays & Display Engineering Laboratory (Prof. Wook-Sung Kim), POSTECH

- Developed LC-based tunable RF/mmWave components, including phase shifters, filters and antenna-related platforms, with industrial partners, and reviewed the field of LC microwave/mmWave devices (*Advanced Materials*, 2023, Frontispiece Cover; first author).
- Project Lead, LC Printing for Smart Devices (Jan – Aug 2025): led the development of drop-on-demand printed LC pixels and smart-window devices.
- Developed inkjet-printed cholesteric LC pixels with frequency-addressable optical memory for reflective displays (*ACS Appl. Mater. Interfaces*, 2026; co-first and corresponding author).
- Sponsored LC-antenna research collaboration with Samsung Electronics MX Division (Antenna Prior Research Organization, 2023).

Intern, Preliminary Research Team for OLED
LG Display, Seoul

PUBLICATIONS

* corresponding author · † equal contribution · name variants: J. Ma, J.-S. Ma, J. S. Ma · Google Scholar

International journal articles · 23 published

- 1 J. Ma[†], G.-Y. Park[†], G. Lee, H.-W. Lee, J.-W. Yu*, and D. K. Yoon*, "Coating-Free Nanoscratching for Liquid-Crystal Alignment on PCB-Compatible Millimeter-Wave Reflective Unit Cells," *Advanced Materials Technologies*, 11(18), e71166, 2026. DOI ↗
- 2 J. Guo[†], X. Qiu[†], R. Zhang, Q. Han, L. Deng, Y. Lu, Z. Zhao, M. Li, W. Kamal, J. Ma, Y. Ma, S. J. Elston, A. A. Castrejón-Pita, S. M. Morris, and C. He, "Drop-on-Demand Printed Negative Dielectric Anisotropy Liquid Crystal Droplets for Adaptive Complex Beam Manipulation and Assessment," *Advanced Functional Materials*, e78645, 2026. DOI ↗ arXiv ↗
- 3 S.-G. Park, J. Ma, S.-W. Oh*, and W. Kim*, "Reducing External Light Interference in OST HMDs via Perceptual-Metric-Guided Pattern Design," *IEEE Photonics Technology Letters*, 38(22), 1869–1871, 2026. DOI ↗
- 4 A. Pradeep*, U. Mur, J. Qin, J. Ka, W. Kamal, T. Wang, J. Ma, S. J. Elston*, and S. M. Morris*, "Field-Programmable Topological Torons in Chiral Nematic Liquid Crystals," *ACS Applied Materials & Interfaces*, 18(38), 52875–52890, 2026. DOI ↗
- 5 J. Ma[†],*, D. Lee[†], H.-W. Oh, G. Ryu, J.-Y. Choi, S.-W. Oh, J.-H. Ka, A. Pradeep, J. Guo, S. Jung*, and W.-S. Kim*, "Inkjet-Printed Cholesteric Liquid Crystal Pixels with Frequency-Addressable Optical Memory for Energy-Efficient Reflective Displays," *ACS Applied Materials & Interfaces*, 18, 17929–17946, 2026. DOI ↗
- 6 A. Pradeep*, Y. Montelongo, J. Ma, Z. Xu, T. Wang, J. Qin, C. Nourshargh, M. J. Booth, S. J. Elston*, and S. M. Morris*, "From Millimeters to Microns: A Hybrid Strategy for Reconfigurable Liquid-Crystal Patterning," *Small Methods*, 10(5), e01892, 2026. DOI ↗
- 7 I.-B. Kong, T.-H. Seo, J. Ma, S.-O. Cha, W.-S. Kim, and S.-W. Lee, "Isolated High-Voltage-Gain Full-Range Soft-Switching DC/DC Converter Using Built-In Transformer and Coupled Inductors With Minimum Design Constraints," *IEEE Transactions on Industrial Electronics*, 73(7), 9899–9911, 2026. DOI ↗
- 8 B. C. Mee, W. Kamal, J. Ma, S. J. Elston, A. A. Castrejón-Pita, W. Whittow, S. M. Morris, and J. P. Coon, "Reconfigurable Optically Transparent Antenna Using Drop-on-Demand Printed Nematic Liquid Crystals," *Advances in Materials Science and Engineering*, 2026, 3279833. DOI ↗
- 9 J.-M. Baek, S.-G. Park, J. Ma, S. Bae, and S.-W. Oh*, "A Numerical Study on a Voltage-Tunable Quasi-Broadband Depolarizer Enabled by Periodic Protrusion-Induced Liquid Crystal Reorientation," *Current Applied Physics*, 90, 8–12, 2026. DOI ↗

- 10 **J. Ma**, A. Pradeep, S.-W. Oh, J.-H. Lee, J.-Y. Choi, S.-O. Cha, H.-W. Oh, and W.-S. Kim*, "Operating Temperature Control in Push-Pull Azobenzene-Doped Liquid Crystal Light-Driven Devices via a UV Absorber," *Dyes and Pigments*, 244, 113145, 2026. [DOI ↗](#)
- 11 J.-Y. Choi, **J. Ma**, and W.-S. Kim*, "Tunable High-Selectivity Wideband Bandpass Filter Using Triple-Mode Stub-Loaded Resonators Based on Liquid Crystals," *IEEE Access*, 13, 186090–186102, 2025. [DOI ↗](#)
- 12 **J. Ma**, W. Kamal*, A. Pradeep, A. J. Orr, S.-W. Oh, J.-Y. Choi, J. Guo, B. Mee, H.-W. Oh, J.-H. Lee, A. A. Castrejón-Pita*, S. J. Elston*, W.-S. Kim*, and S. M. Morris*, "Advanced Image-Integrated Smart Windows Using Printed Electrochromic Polymer-Dispersed Liquid Crystal Droplets," *Advanced Optical Materials*, 13(31), e01586, 2025. [Hot Topic](#) [DOI ↗](#)
- 13 S.-H. Lee†, S.-G. Park†, **J. Ma**, W.-S. Kim, and S.-W. Oh*, "High-Performance Switchable Visor for Augmented Reality Using Low-Voltage, Fast-Response Cholesteric Liquid Crystals," *Dyes and Pigments*, 243, 113068, 2025. [DOI ↗](#)
- 14 S.-O. Cha, J.-H. Ka, I.-B. Kong, **J. Ma**, S. Park, and W.-S. Kim*, "Off-Center Rotational Dynamics in Virtual Reality: Effects on Cybersickness and Presence," *IEEE Access*, 13, 109473–109483, 2025. [DOI ↗](#)
- 15 A. Pradeep*, U. Mur, **J. Ma**, N. Spiller, Y. Jin, W. Kamal, S. J. Elston*, and S. M. Morris*, "Locking Metastable Topological Domains in Nematic Liquid Crystal Pi Cells," *Advanced Functional Materials*, 35(51), e12550, 2025. [Editor's Choice](#) [DOI ↗](#)
- 16 J.-Y. Choi, **J. Ma**, and W.-S. Kim*, "Reconfigurable Wideband Bandpass Filter Using Stepped Impedance Resonator Based on Liquid Crystals," *Electronics*, 14(12), 2325, 2025. [Editor's Choice](#) [DOI ↗](#)
- 17 S. Park, **J. Ma**, S.-W. Oh*, and W.-S. Kim*, "Blur Image Representation in Defocus Using Generalized Gaussian Kernel," *Journal of Information Display*, 26(3), 321–328, 2025. [DOI ↗](#)
- 18 J.-Y. Choi, **J. Ma**, H. Oh, and W.-S. Kim*, "A Reconfigurable Narrow-Band Bandpass Filter Using Electrically Coupled Open-Loop Resonators Based on Liquid Crystals," *Journal of Physics D: Applied Physics*, 57(46), 465307, 2024. [DOI ↗](#)
- 19 J.-H. Lee, **J. Ma**, C.-H. An, G.-H. Lee, and S.-W. Oh*, "Advanced Light: Liquid Crystals-Based Ultra-Broadband Polarization Rotator for Functional Smart Devices," *Small Methods*, 8(3), 2301106, 2024. [DOI ↗](#)
- 20 **J. Ma**, J.-Y. Choi, S. Park, I. Kong, D. Kim, C. Lee, Y. Youn, M. Hwang, S.-W. Oh*, W. Hong*, and W.-S. Kim*, "Liquid Crystals for Advanced Smart Devices with Microwave and Millimeter-Wave Applications: Recent Progress for Next-Generation Communications," *Advanced Materials*, 35(45), 2302474, 2023. [Frontispiece Cover](#) [DOI ↗](#)
- 21 H. Shin†, **J. Ma**†, J.-Y. Choi†, and W.-S. Kim*, "Phase Shifting Enhancement of a Substrate-Integrated Waveguide Phase Shifter Based on Liquid Crystal," *Applied Sciences*, 13(4), 2504, 2023. [DOI ↗](#)
- 22 **J. Ma**, J.-Y. Choi, H.-J. Shin, J.-H. Lee, S.-W. Oh*, and W.-S. Kim*, "An Evaluation of Surface-Active Agent Hexadecyltrimethylammonium Bromide with Vertical Self-Alignment Properties to Align Liquid Crystals for Various Cell Gap Conditions," *Applied Sciences*, 12(24), 12582, 2022. [DOI ↗](#)
- 23 **J. Ma**, J.-Y. Choi, S.-W. Oh, and W.-S. Kim*, "Liquid-Crystal-Based Floating-Electrode-Free Coplanar Waveguide Phase Shifter with an Additional Liquid-Crystal Layer for 28-GHz Applications," *Journal of Physics D: Applied Physics*, 55(9), 095106, 2022. [DOI ↗](#)

Korean-society journal · 1 article

- K1 **J. Ma**, J.-Y. Choi, and W.-S. Kim, "액정의 고주파 대역 특성과 RF 응용 기술 동향 [High-Frequency Properties of Liquid Crystals and Trends in RF Application Technologies]," *Information Display*, 22(3), 15–26, 2021 (in Korean). [ResearchGate ↗](#)

Submitted / Under Review · 4 manuscripts

- S1** **J. Ma***, H. S. Yun, B. Kim, J. Kim, L. Wang*, J.-M. Heo*, and D. K. Yoon*, "Electrical Translation of a Chromatic Trajectory Enables Subpixel-Free Color Generation," *Laser & Photonics Reviews*, 2026, submitted.
- S2** **J. Ma†**, S. Bang†, D.-O. Kim*, J. Oh*, and D. K. Yoon*, "Phase-Tuning and Switching Characteristics of a 160-GHz Liquid-Crystal Reconfigurable Intelligent Surface With Matched and Mismatched Chiral Twist," *IEEE Access*, 2026, submitted.
- S3** B. Kim†, J. Kim†, G. Lee†, Y. Kim, H. Ahn, **J. Ma**, Y. H. Kim*, H. Y. Kim*, and D. K. Yoon*, "Dual-Parameter Control of Low- κ Liquid Crystal Polymer Films for GHz-Frequency Dielectric Applications via Porogen-Induced Porosity and Molecular Alignment," *Journal of Information Display*, 2026, under revision.
- S4** J.-Y. Choi, **J.-S. Ma**, J.-S. Park, W.-S. Kim*, and H.-R. Kim*, "Low-Voltage Tunable Bandpass Filter with Selective Center-Frequency and Bandwidth Control Using Liquid-Crystal-Loaded Lines," *Journal of Information Display*, 2026, submitted.

HONORS, FELLOWSHIPS & AWARDS

- 2026** Kim Beom-Man Best Ph.D. Dissertation Award, Department of Electrical Engineering, POSTECH
- 2025–26** Jang Young-Sil Postdoctoral Fellowship (Sep 2025 – Aug 2026), KAIST / National Research Foundation of Korea
- 2025** BK21 FOUR Outstanding Graduate Student Award for Overseas Research (one of 14 recipients nationwide), National Research Foundation of Korea and Ministry of Education
- 2024** POSTECHIAN Fellowship, POSTECH
- 2024** Excellent Paper Challenge Prize, POSTECH Best Paper Competition
- 2024** Excellence Award (2nd Prize), Electrical Engineering Outstanding Performance Contest, POSTECH
- 2023** Grand Prize, 8th Electromagnetic Wave Measurement Thesis Contest, Korean Institute of Electromagnetic Engineering and Science
- 2023** BK21 FOUR Outstanding Graduate Student International Funding (University of Oxford visit)
- 2023** BK21 Interdisciplinary Research Group Support Funding, POSTECH
- 2018–2019** Kim Jong-Han Foundation Scholarship

PATENTS

- **J.-S. Ma** and D. K. Yoon, "Liquid Crystal Device Including Chiral Dopant and Manufacturing Method Thereof," Korean Patent Application No. 10-2026-0083417, filed Mar. 20, 2026.

INVITED TALK & CONFERENCE PRESENTATIONS

Invited talk: "Liquid Crystal Engineering: From Molecular Alignment to Advanced Devices," Chungnam National University (host: Prof. Jun-Hee Na), April 22, 2026.

International conferences

- **J. Ma** and D. K. Yoon, "Electrically Addressable Subpixel-Free Color Generation in Liquid-Crystal Heterostructures for Programmable Electromagnetic Surfaces," IMID, 2026 (poster).
- H. Oh, S. Park, J.-Y. Choi, **J. Ma**, S. Choi, and W.-S. Kim, "Analysis of Meander Delay Line Liquid Crystal Phase Shifter Using Director Angle Extraction," IMID, 2024.
- J.-Y. Choi, **J. Ma**, H. Oh, and W. Kim, "Characterization of Nematic Liquid Crystals at 10 GHz Using an Open Stub Resonator," IEEE AP-S/URSI, 2024. [DOI ↗](#)
- **J. Ma**, et al., "Enhancing Light-Driven Polymer Stabilized Liquid Crystal Smart Devices," British Liquid Crystal Society, 2024. [Abstract PDF ↗](#)

- J.-Y. Choi, **J. Ma**, et al., "Reconfigurable Phased Array Antenna Based on Liquid Crystal with Miniaturized Bandpass Filter," ISAP, 2022. [DOI ↗](#)
- H. Shin, J.-Y. Choi, **J. Ma**, and W.-S. Kim, "Phase Shift Enhancement of Substrate Integrated Waveguide Phase Shifter Using Liquid Crystal," IMID, 2022.
- **J. Ma**, J.-Y. Choi, H.-J. Shin, and W.-S. Kim, "Comparative Analysis of Liquid-Crystal Driving between the Grounded-Coplanar Waveguide and the Floating-Electrode-Free Coplanar Waveguide in Liquid-Crystal Phase Shifters," IEEE AP-S/URSI, 2022. [DOI ↗](#)
- **J. Ma**, et al., "Analysis about Novel Design of Liquid Crystal Based Floating Electrode Free Coplanar Waveguide Phase Shifter," IMID, 2021.
- S. Cha, **J. Ma**, et al., "Concept and Numerical Modeling for Virtual Acceleration Sense on Vestibular Organ Using Focused Ultrasound," IMID, 2020.

Domestic conferences

- **J. Ma**, et al., "Liquid Crystal Printing as a Spatially Programmable Platform for Decoupled Optical Functionality," Korean Meeting on Information Display, 2026.
- J.-Y. Choi, **J. Ma**, et al., "Characterization of Nematic Liquid Crystal at 10 GHz Using Director Angle Extraction," Korea Liquid Crystal Conference, 2024.
- J.-Y. Choi, **J. Ma**, et al., "전기적 커플링 오픈 스텐브를 이용한 소형 액정 기반 가변 광대역 대역저지 필터 [Compact Liquid-Crystal-Based Tunable Wideband Bandstop Filter Using Electrically Coupled Open Stubs]," IEIE Summer Conference, 2023.

RESEARCH PROJECTS

LC Printing for Smart Devices · POSTECH, Jan 2025 – Aug 2025. Project Lead.

6G Core Technology Development Program (fast-switching LC antennas for reconfigurable intelligent surfaces), IITP, Korea, with KAIST, Sep 2025 – Aug 2026. Participating researcher.

Lightweight LC-Based mmWave Beamforming Antenna System · Agency for Defense Development, project period Dec 2021 – Nov 2026. Participating researcher.

CORE: Sub-THz 6G · Samsung Science & Technology Foundation, Sep 2021 – Sep 2024. Participating researcher.

LC-Based RF Applications and Commercialization · JNC Corporation, Japan, Sep 2020 – Aug 2024. Participating researcher.

Antenna Prior Research (sponsored collaboration) · Samsung Electronics MX Division, POSTECH, 2023.

ACADEMIC SERVICE

Journal reviewer: *Light: Science & Applications*; *Advanced Optical Materials*; *Liquid Crystals*; *Journal of Physics D: Applied Physics*; *Dyes and Pigments*; *Engineering Research Express*; *Photonics*; *Electronics*.

REFERENCES

Prof. Dong Ki Yoon

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Prof. Stephen M. Morris

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 Science, University of Oxford
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 SUPERVISOR**
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