Exponent®
Engineering & Scientific Consulting

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Professional Profile

Dr. Kaichen Gu's areas of technical expertise center on developing structure-function relationships for emerging materials for optoelectronics using analytical and microscopic techniques. He has worked on a variety of materials including polymers, small molecules, and halide perovskites.

During his doctoral studies at Princeton University, in collaboration with researchers at National Institute of Standards and Technology (NIST) and ExxonMobil, Dr. Gu systematically investigated the microstructural features that determine polymers' macroscopic mechanical and electrical properties and gained insights into the critical role of the intercrystallite molecular connections, i.e., the polymer tie chains.

Dr. Gu has extensive experience in various characterization techniques including scanning electron microscopy (SEM), energy dispersive X-ray spectroscopy (EDS), transmission electron microscopy (TEM), small-angle and wide-angle X-ray scattering (SAXS and WAXS), nuclear magnetic resonance (NMR) spectroscopy, ultraviolet–visible (UV-vis) spectroscopy, atomic force microscopy (AFM), ellipsometry, contact angle goniometry, size-exclusion chromatography (SEC), thermogravimetric analysis (TGA), and differential scanning calorimetry (DSC). Dr. Gu applies these characterization techniques to solve problems involving semiconductors, electronic packaging, displays, user interfaces, and electronic assemblies.

Prior to joining Exponent, Dr. Gu was a postdoctoral research associate at the University of Wisconsin-Madison where he leveraged four-dimensional scanning transmission electron microscopy (4D STEM) to investigate the nanostructure of vapor-deposited glassy thin films for electronic applications.

Academic Credentials & Professional Honors

Ph.D., Chemical Engineering, Princeton University, 2020

M.Eng., Chemical Engineering, University of Cambridge, England, 2015

B.S., Chemical Engineering, University of Cambridge, England, 2014

The School of Engineering and Applied Science Award for Excellence, Princeton University, 2019

Frank J. Padden Award finalist, Division of Polymer Physics, American Physical Society, 2019

SABIC Award for Best General Exam Performance (Department of Chemical Engineering), Princeton University, 2017

ExxonMobil Emerging Technology Fellowship, Princeton University, 2016-2019

Trinity College Overseas Bursaries, University of Cambridge, U.K., 2011-2015

Prior Experience

Postdoctoral Research Associate, Department of Chemistry, University of Wisconsin-Madison, 2020-2021

Professional Affiliations

American Physical Society

American Chemical Society

Publications

Y. Gao, Y. Ge, X. Wang, J. Liu, W. Liu, Y. Cao, K. Gu, Z. Guo, Y.-M. Wei, H. Meng, X.-F. Yu, H. Zheng, W. Huang, J. Li. “Ultrathin and ultrasensitive direct X-ray detector based on heterojunction phototransistors”. Adv. Mater. 2021, 33, 2101717.

Y. Xia, R. Li, E. Tsai, Y. He, T. Liu, X. Zhao, K. Gu, H. Meng, Y.-L. Loo. “Solvent-free coating of organic semiconductor membranes with large-area single-crystalline domains”. Adv. Electron. Mater. 2021, 7, 2000792.

K. Gu, Y. Wang, R. Li, E. Tsai, J. Onorato, C.K. Luscombe, R.D. Priestley, Y.-L. Loo. “Role of postdeposition thermal annealing on intracrystallite and intercrystallite structuring and charge transport in poly(3-hexylthiophene)”. ACS Appl. Mater. Interfaces. 2021, 13, 999-1007.

Y. Wang, K. Gu, A. Soman, T. Gu, R.A. Register, Y.-L. Loo, R.D. Priestley. “Circumventing macroscopic phase separation in immiscible polymer mixtures by bottom-up deposition”. Macromolecules 2020, 53, 5740-5746.

K. Gu, J. Onorato, C.K. Luscombe, Y.-L. Loo. “The role of tie chains on the mechano-electrical properties of semiconducting polymer films”. Adv. Electron. Mater. 2020, 6, 1901070

X. Zhao, C. Yao, K. Gu, T. Liu, Y. Xia, Y.-L. Loo. “A hole-transport material that also passivates perovskite surface defects for solar cells with improved efficiency and stability”. Energy Environ. Sci., 2020, 13, 4334-4343.

C. Yao, Y. Zhu, K. Gu, J. Zhao, J. Ning, Y.-L. Loo, H. Meng. “Fluorinate a polymer donor through trifluoromethyl group for high-performance polymer solar cells”. J. Mater. Chem. A, 2020, 8, 12149-12155.

K. Gu*, Y.-L. Loo*. “The polymer physics of multiscale charge transport in conjugated systems”. J. Polym. Sci. Part B Polym. Phys. 2019, 57, 1559-1571.

Y. Wang, K. Gu, H. Jeong, M. Chowdhury, X. Monnier, D. Cangialosi, Y.-L. Loo, R.D. Priestley. “Tunable properties of MAPLE-deposited thin films in the presence of suppressed segmental dynamics”. ACS Macro Lett. 2019, 8, 1115-1121.

J.C. Sorli, D.B. Granger, Q. Ai, K. Gu, S. Parkin, C. Risko, J. Anthony, Y.-L. Loo. “The impact of atomistic substitution on thin-film structure and charge transport in a germanyl-ethynyl functionalized pentacene”. Chem. Mater. 2019, 31, 6615-6623.

A.J. Petty II, Q. Ai, J.C. Sorli, H.F. Haneef, G.E. Purdum, A. Boehm, D.B. Granger, K. Gu, C.P.L. Rubinger, S.R. Parkin, K.R. Graham, O.D. Jurchescu, Y.-L. Loo, C. Risko, J.E. Anthony. “Computationally

aided design of a high-performance organic semiconductor via the development of a universal crystal engineering core". Chem. Sci. 2019, 10, 10543-10549.

K. Gu, C.R. Snyder, J. Onorato, C.K. Luscombe, A.W. Bosse, Y.-L. Loo. "Assessing the Huang-Brown description of tie chains for charge transport in conjugated polymers". ACS Macro Lett. 2018, 7, 1333-1338.

K. Gu, J. Onorato, S.S. Xiao, C.K. Luscombe, Y.-L. Loo. "Determination of the molecular weight of conjugated polymers with diffusion-ordered NMR spectroscopy". Chem. Mater. 2018, 30, 570-576.

K. Gu, V. S. Vassiliadis. "Limitations in using Euler's formula in the design of heat exchanger networks with Pinch Technology". Comput. Chem. Eng. 2014, 68, 123-127.

Presentations

Invited talk at Scattering Journal Club at Brookhaven National Laboratory. April 28, 2020. "Understanding the role of intercrystallite tie chains on charge transport in conjugated polymers". Virtual.

Invited talk at Padden Award Symposium at American Physical Society (APS) March Meeting. "Quantitative assessment of tie chains for charge transport in conjugated polymers". March 5, 2019. Boston, MA.

Invited talk at Cornell Laboratory for Accelerator-based Sciences and Education (CLASSE) Seminar. "Quantifying the probability of tie-chain formation in semicrystalline conjugated polymers and elucidating its impact on charge transport" March 29, 2018. Ithaca, NY.

Invited Talk at National Institute of Standards and Technology. "Quantification of tie-chain content in conjugated polymers and its impact on charge transport properties". Dec 6, 2017. Gaithersburg, MD.

Invited Talk at ExxonMobil's Corporate Strategic Research Laboratory. "Quantitative assessment of tie chains for charge transport in conjugated polymers". July 21, 2017. Annandale, NJ.