

Gözde Sultan Demirer, PhD

Assistant Professor | Chemistry & Chemical Engineering | California Institute of Technology
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SUMMARY

My research group aims to solve the critical challenge of **sustainable production of more food with fewer resources** via interdisciplinary approaches of synthetic biology, chemistry, nanomaterials, plant gene editing, and plant-microbe interactions. [Research talks](#) are available on the lab website. I strive to implement best practices in **mentoring, professional development, and [Diversity, Equity, Inclusion & Accessibility](#)** as an educator.

POSITIONS AND AFFILIATIONS

California Institute of Technology, Pasadena, CA September 2022 - present
Clare B. Luce Assistant Professor, Chemical Engineering

University of California, Davis, Davis, CA August 2020 - September 2022
Postdoctoral Fellow, Plant Biology and Genome Center
Advisor: Siobhan M. Brady

EDUCATION

University of California, Berkeley August 2015 - May 2020
Ph.D. Chemical and Biomolecular Engineering
Advisor: Markita P. Landry

Koç University, Istanbul, Turkey September 2010 - June 2015
B.S. Chemical and Biological Engineering

HONORS AND AWARDS

Since starting at Caltech

Journal of Nanobiotechnology (JNB) Rising Star Award (about)	2026
Jane Silverthorne Early Career Award by American Society of Plant Biologists (about)	2025
Keystone Symposia ECITA Award (about)	2025
Rising Stars in Plant Sciences Award by Molecular Plant (about)	2024
Zero Hunger Award by American Chemical Society (ACS)	2024
AIChE's 35 under 35 Award (about)	2023
CCE Chair's Council Innovation Award (about)	2023
Clare Boothe Luce Professorship Award (about)	2022-2027
Resnick Sustainability Institute Postdoctoral Fellowship (about)	2020-2022
Science and Technology in Society Forum Young Leader (about)	2022

Before Caltech

UC Davis PSA Travel Grant Awardee	2022
Justice, Equity, Diversity, and Inclusion Award, Life Science Editors Foundation (about)	2021
Faculty for the Future Fellowship, Schlumberger Foundation (about)	2016-2020
MIT Chemical Engineering Rising Star (about)	2019
WCC/Merck Research Award (about)	2019
UC Berkeley Graduate Division Travel Grant	2019
AIChE 2019, Bionanotechnology Graduate Student Award Session, 2 nd place	2019
Women's Initiative Committee's (WIC) Travel Award (about)	2018
AIChE 2018, Carbon Nanomaterials Graduate Student Award Session, 2 nd place	2018
AIChE 2017, Bionanotechnology Graduate Student Award Session, 3 rd place	2017
Eltoukhy East-West Gateway Fellowship (about)	2015-2016
B.S. Valedictorian, Top Ranking Student Award	2015

Since starting at Caltech

1. Li E., Berruto C., Oz T., Grillo E., Griffin C., ... **Demirer GS**[‡]. Sentinel plants enable quantitative monitoring of bioavailable nitrate in soils and microbial environments. *bioRxiv* (2026). doi.org/10.64898/2026.03.18.712767
2. Wang Y., Marken J., Li E., Tarr P., Meyerowitz E., **Demirer GS**[‡]. Sentinel Plants Enable Aboveground Detection of Belowground Soil Microbial Activity. *bioRxiv* (2026). doi.org/10.64898/2026.03.23.713735
3. McCombe CL., **Demirer GS**[‡]. Fundamental and Applied Insights into Peptide Hormones Linking Nitrogen and Phosphate Sensing to Microbial Interactions. *npj Science of Plants*. (2026). doi.org/10.1038/s44383-025-00018-0
4. Li E.*, Geng Y.*, Khristoforova TR., Wang Y., Jones J., **Demirer GS**[‡]. Vacuum and sonication treatment enables efficient transient gene expression in various monocot and eudicot plant seedlings. *ACS Synthetic Biology*, (2026). doi.org/10.1021/acssynbio.5c00855
5. Berruto C., Grillo E., Esturi S. **Demirer GS**[‡]. A 3D Printed Capillary Tube Holder for High-Throughput Chemotaxis Assays. *J Bacteriol* (2026). doi.org/10.1128/jb.00384-25
6. Abu-Remaileh, M., Chan, C.J., Chen, L., **Demirer GS** et al. Visions of the future of molecular cell biology. *Nat Rev Mol Cell Biol* 26, 735–740 (2025). doi.org/10.1038/s41580-025-00892-7
7. Legendre MG., Heredia A., Colee C. **Demirer GS**[‡]. Extracellular contractile injection systems for high efficiency protein delivery to plants. *bioRxiv*, (2025). doi.org/10.1101/2025.08.22.671880
8. Muchenje KT., Wang Y., Oz TM., Saffron A., **Demirer GS**[‡]. Optimized R2 Retrotransposon Complexes Enable Precise and Efficient DNA Insertion into Plant Genomes. *bioRxiv*, (2025). doi.org/10.1101/2025.08.22.671877
9. Bian, C.*, **Demirer, GS***, Oz, MT.* et al. Conservation and divergence of regulatory architecture in nitrate-responsive plant gene circuits. *The Plant Cell*, 37(6), (2025). doi.org/10.1093/plcell/koaf124
10. Legendre M., Pistilli V., **Demirer GS**[‡]. Chemical conjugation innovations for protein nanoparticles. *Trends in Chemistry*, 6 (8), 470-486, (2024). doi.org/10.1016/j.trechm.2024.06.004
11. Griffin C., Oz TM., **Demirer GS**[‡]. Engineering plant-microbe communication for plant nutrient use efficiency. *Current Opinion in Biotechnology*, 88, 103150, (2024). doi.org/10.1016/j.copbio.2024.103150
12. Berruto C. and **Demirer GS**[‡]. Engineering agricultural soil microbiomes and predicting plant phenotypes. *Trends in Microbiology*, 32 (9), 858-873, (2024). doi.org/10.1016/j.tim.2024.02.003
13. Krasley AT.*, Li E.*, Galeana JM., Bulumulla C., Beyene AG.[‡], **Demirer GS**[‡]. Carbon nanomaterial fluorescent probes and their biological applications. *Chemical Reviews*, 124 (6), (2024). doi.org/10.1021/acs.chemrev.3c00581
14. Lowry G.*, Giraldo JP.*, Steinmetz N.*, Avellan A., **Demirer GS** et al. Towards realizing nano-enabled precision delivery in plants. *Nature Nanotechnology*, 19 (9), 1255-1269, (2024). doi.org/10.1038/s41565-024-01667-5
15. **Demirer GS***, Gibson D.*, Yue X., Pan K., Cantó-Pastor A. et al. Phosphate deprivation-induced changes in tomato are mediated by an interaction between brassinosteroid signaling and zinc. *New Phytologist*, 239 (4), 1368-1383, (2023). doi.org/10.1111/nph.19007
16. Wang Y. and **Demirer GS**[‡]. Synthetic Biology for Plant Genetic Engineering and Molecular Farming. *Trends in Biotechnology*, 41 (9), 1182-1198, (2023). doi.org/10.1016/j.tibtech.2023.03.007
17. **Demirer GS**[‡]. Detecting and quantifying nanoparticle-mediated biomolecule delivery in plants. *Nature Reviews Methods Primers*, 3 (1), 16, (2023). doi.org/10.1038/s43586-023-00213-2
18. Legendre M., and **Demirer GS**[‡]. Improving crop genetic transformation to feed the world. *Trends in Biotechnology*, 41 (3), 264-266, (2022). doi.org/10.1016/j.tibtech.2022.12.002
19. Rustgi S.[‡], Naveed S., Windham J., Zhang H., and **Demirer GS**[‡]. Plant biomacromolecule delivery methods in the 21st century. *Frontiers in Genome Editing*, 4, 1011934, (2022). doi.org/10.3389/fged.2022.1011934

Before Caltech

20. Park J., **Demirer GS**., Cheung L. Toolboxes for Plant Systems Biology Research. *Current Opinion in Biotechnology*, 75, 102692, (2022). doi.org/10.1016/j.copbio.2022.102692
21. **Demirer GS***, Bian C.*, Brady SM. GLRs: Mediating a defense-regeneration tradeoff in plants. *Developmental Cell*, 57 (4), 417-418, (2022). doi.org/10.1016/j.devcel.2022.02.007.
22. Ali Z., Serag M., **Demirer GS**. et al. DNA-carbon nanotube binding mode determines the efficiency of carbon nanotube-mediated DNA delivery to intact plants. *ACS ANM*, 5 (4), (2022). doi.org/10.1021/acsanm.1c03482

23. **Demirer GS**[‡]. Wonder wheat: A disease-resistant crop without growth tradeoff. *GEN Biotechnology*, 1 (2), 133-134 (2022). doi.org/10.1089/genbio.2022.29016.gde
24. Zhang H., Goh NS., Wang J., **Demirer GS.** et al. Nanoparticle Cellular Internalization is Not Required for RNA Delivery to Mature Plant Leaves. *Nature Nanotechnol*, 17, 197-205, (2021). doi.org/10.1038/s41565-021-01018-8
25. González-Grandío E., **Demirer GS.** et al. Carbon nanotube biocompatibility in plants is determined by their surface chemistry. *Journal of Nanobiotechnology*, 19 (1), 431, (2021). doi.org /10.1186/s12951-021-01178-8
26. González-Grandío E., **Demirer GS.**, Ma W., Brady SM., Landry MP. A ratiometric dual color luciferase reporter for fast characterization of transcriptional regulatory elements in plants. *ACS SynBio*, 10 (10), 2763-2766, (2021). doi.org/10.1021/acssynbio.1c00248
27. **Demirer GS.**[‡] and Landry[‡], M.P. Efficient Gene Knock-Down in Tobacco Plants Using Carbon Nanocarriers. *Bio-protocol*, 5;11(1):e3897, (2021). doi.org/10.21769/bioprotoc.3897
28. Zhang H.* , Cao Y.* , Xu D., Goh NS., **Demirer GS.**, Landry MP., Yang P. Gold nanocluster mediated delivery of siRNA to intact plant cells for efficient gene knockdown. *Nano Letters*, 21 (13), 5859-5866, (2021). doi.org/10.1021/acs.nanolett.1c01792
29. **Demirer GS.**[‡], Silva TN., Thomas B., Jackson CT., Mortimer JC.[‡], Rhee SY.[‡], Landry MP[‡]. Nanotechnology to advance CRISPR/Cas genetic engineering of plants. *Nature Nanotechnology*, 16 (3), 243-250, (2021). doi.org/10.1038/s41565-021-00854-y
30. Zhang H., **Demirer GS.**, Fan C. and Landry M.P. Engineering DNA nanostructures for efficient delivery in plant cells. *Nature Protocols*, 15 (9), 3064-3087, (2020). doi.org/10.1038/s41596-020-0370-0
31. **Demirer GS.**, Zhang H., Goh N., Pinals R.L., Chang R., Landry M.P. Carbon nanocarriers deliver siRNA to intact plant cells for efficient gene knockdown. *Science Advances*, 6 (26), (2020). doi.org/10.1126/sciadv.aaz0495
32. **Demirer GS***, Goh NS.* , Cunningham FJ.* , Zhang H* , Landry MP. Nano-biostics: A novel plant genetic transformation approach. *Methods in Molecular Biology*, 141-159, (2020). doi:10.1007/978-1-0716-0356-7_7
33. **Demirer GS.**, Zhang H., et al. Carbon nanotube-mediated DNA delivery without transgene integration in intact plants. *Nature Protocols*, 14 (10), 2954-2971, (2019). doi.org/10.1038/s41596-019-0208-9
34. Wang J., Grandio G., Newkirk M., **Demirer GS.** et al. Nanoparticle mediated genetic engineering of plants. *Molecular Plant*, 12 (8), 1037-1040, (2019). doi.org/10.1016/j.molp.2019.06.010
35. **Demirer GS.***, Zhang Hu.* , Zhang Ho., Ye T., Goh NS., Aditham AJ., Cunningham FJ., Fan. C., Landry MP. DNA nanostructures coordinate gene silencing in mature plants. *PNAS*, 116 (15) 7543-7548, (2019). doi.org/10.1073/pnas.1818290116
36. **Demirer GS.**, Zhang H., Matos J., Goh N., et al. High Aspect Ratio Nanomaterials Enable Delivery of Functional Genetic Material Without Transgenic DNA Integration in Mature Plants. *Nature Nanotechnology*, 14 (5), 456-464, (2019). doi.org/10.1038/s41565-019-0382-5
37. Cunningham FJ* , Goh NS.* , **Demirer GS.**, Matos J., Landry MP. Nanoparticle-mediated delivery in plants towards advancing plant genetic engineering, *Trends in Biotechnology*, 36 (9), 882-897, (2018). doi.org /10.1016/j.tibtech.2018.03.009.
38. **Demirer GS.** and Landry MP. Delivering Genes to Plants. *Chemical Engineering Progress*, 113 (4), 40-45, (2017). escholarship.org/uc/item/2hp0j2g2.
39. Del Bonis JT., Beyene AG., Chio L., **Demirer GS.**, Yang D., Landry MP. Engineering Molecular Recognition with Bio-mimetic Polymers on Single Walled Carbon Nanotubes. *JOVE*, 55030 (2017). doi.org/10.3791/55030.
40. **Demirer GS.***, Beyene AG.* , Landry MP. Nanoparticle-templated molecular recognition platforms for detection of biological analytes. *Curr. Protoc. Chem. Biol.* 8:197-223 (2016). doi.org/10.1002/cpch.10.
41. **Demirer GS.**, Okur AC., Kizilel SS. Synthesis and Design of Biologically Inspired Biocompatible Iron Oxide Nanoparticles for Biomedical Applications. *Journal of Materials Chemistry B*, 3 (40), 7831-7849, (2015). doi.org/10.1039/C5TB00931F.
42. Nazli C., **Demirer GS.**, Yar Y., Acar HY., Kizilel SS. Targeted Delivery of Doxorubicin into Tumor Cells via MMP-sensitive PEG Hydrogel Coated Magnetic Iron Oxide Nanoparticles, *Colloids and Surfaces B: Biointerfaces*, 122, 674-683, (2014). doi.org/10.1016/j.colsurfb.2014.07.049.

PATENTS

1. **Demirer GS.**, Muchenje K. Optimized R2 Retroelement Complexes Enable Precise and Efficient DNA Insertion into Plant Genomes. Provisional patent filed, October 2025, CIT-9388-P.
2. **Demirer GS.**, Berruto C. A 3D-Printed Capillary Tube Holder for High-Throughput Chemotaxis Assays. Provisional patent filed, October 2025, CIT-9387-P.
3. **Demirer GS.**, Legendre M. Extracellular Contractile Injection Systems for High Efficiency Protein Delivery to Plants. Provisional patent filed, October 2025, CIT-9390-P.
4. **Demirer GS.**, Li E. Vacuum and Sonication Treatment Enables Efficient Transient Gene Expression in Various Monocot and Eudicot Plant Seedlings. Provisional patent filed, October 2025, CIT-9393-P.
5. **Demirer GS.**, Wang Y., Muchenje K. Targeted DNA Integration in Plants by CRISPR-Associated Transposases. Provisional patent filed, CIT-9134-P. Patent filed, February 2025. U.S. Patent Application No. 30KJ-810004.
6. **Demirer GS.**, Griffin C. Engineering Biofilm-Based Bioinoculants for Climate-Resilient Crops. Provisional patent filed, CIT-9249-P, December 2024. Refiled in December 2025.
7. **Demirer GS.**, Berruto C. Identification of Chemical Targets for The Selective Enrichment of Desirable Bacteria. Provisional patent filed, CIT-9109-P. Patent filed, December 2024. U.S. Patent Application No. 18/972,482.
8. **Demirer GS.**, Legendre M. Genetically Encoded Delivery Vehicles for Plant Genetic Engineering. Provisional patent filed, CIT-9054-P, filed August 2023.
9. Landry MP., **Demirer GS.** Mature plant transfection using carbon nanotubes. International Patent App. 62/500450, 2017. US Patent App. 16/672459, 2020.
10. Landry MP., Zhang H., **Demirer GS.** Gene Silencing in Plants with DNA Origami Nanostructures. Invention disclosure BK-2019-044, filed September 2018.

SELECT INVITED RESEARCH TALKS (since starting at Caltech, total of >60)

1. Keynote speaker at the Synthetic Biology Australasia 2025. Wellington, New Zealand, November 2025.
2. 2025 AIChE Annual Meeting, Nanomaterials: Device and Applications. Boston, MA, November 2025.
3. UC Berkeley Chemical Engineering Department Seminar. Berkeley, CA, August 2025.
4. University of Georgia Plant Synthetic Biology Symposium. Athens, GA, August 2025.
5. 2025 Single-Cell Approaches in Plant Biology GRC. Portland, ME, August 2025.
6. Caltech ESE Weekly Seminar Series: Rhizosphere and Plant Genetic Engineering for Sustainable Agriculture. Pasadena, CA, June 2025.
7. Duke Department of Biology Seminar. Durham, NC, May 2025.
8. Keystone Symposia - Future of Agriculture for Sustainability. Keystone, CO, January 2025.
9. 1st International SynBYSS Conference. University of Hawai'i at Mānoa, HI, December 2024.
10. Texas Tech University 2024 IGCAS Symposium. Lubbock, TX, November 2024.
11. 2024 International Conference on Microbiome Engineering. Boston, MA, November 2024.
12. 2024 AIChE Annual Meeting. San Diego, CA, October 2024.
13. Inside IGI Climate: Panel on Sustainable Crop Improvement. Invited Panelist. Berkeley, CA, October 2024.
14. 7th International Conference on CRISPR Technology. San Diego, CA, October 2024.
15. Bayer Crop Science Plant Biotech Academy Seminar Series. Virtual. October 2024.
16. JGI 2024 Annual Genomics of Energy and Environment Meeting. Walnut Creek, CA, September 2024.
17. Inari Agriculture SLT Science seminar. Virtual. September 2024.
18. Biochemical and Molecular Engineering XXIII: Accelerating Biotech Solutions to aid a Changing World. Dublin, Ireland, July 2024.
19. ICAR 2024: Elucidating Chemical Signals Dictating Plant Microbiome Assembly and Function. San Diego, CA, July 2024.
20. Queensland Alliance for Agriculture and Food Innovation. The University of Queensland, Brisbane, Australia, July 2024.
21. International Plant Molecular Biology (IPMB2024) Congress. Cairns, Australia, June 2024.
22. SEED 2024: CRISPR-associated transposons for high efficiency targeted gene insertion in plants. Atlanta, GA, June 2024.

23. 2024 Plant Molecular Biology GRC. Holderness, New Hampshire, June 2024.
24. 2024 Electrochemical Society Annual Meeting: Cationic Carbon Dots for Plant Gene Delivery and Genetic Engineering Applications. San Francisco, CA, May 2024.
25. 2024 Walter E. & Helen Parke Loomis Symposium at Iowa State University: New Frontiers in Plant Biotechnology. Ames, IA, May 2024.
26. EBRC 2024 Annual Meeting: Plant Microbiome Engineering for Sustainable Agriculture. Atlanta, GA, May 2024.
27. RSI Young Investigators Symposium: Nano and Biotechnology Development for Plant and Planet Health. Pasadena, CA, April 2024.
28. 2024 American Chemical Society Spring Meeting. New Orleans, LA, March 2024.
29. The Donald Danforth Plant Science Center. Olivette, MO, February 2024.
30. Plant SynBio for Space Conference by TRISH. Virtual, August 2023.
31. 2023 ASPB Annual Meeting: Towards a Sustainable Future. Savannah, Georgia, August 2023.
32. 2023 Single Cell Approaches in Plant Biology GRC. Ventura, CA, July 2023.
33. 2023 Environmental Nanotechnology GRC. Newry, ME, June 2023.
34. 12th International Conference on Biomolecular Engineering. Santa Barbara, January 2023.
35. Innovative Genomics Institute CRISPR Journal Club. Virtual, October 2022.
36. The University of Florida Synthetic Biology Working Group Seminar. Virtual, October 2022.
37. Stockbridge School of Agriculture Fall Seminar series at the University of Massachusetts. Virtual, October 2022.
38. 5th International Conference on CRISPR Technologies: Plant gene Editing Enabled by Nanoparticles. Berkeley, CA, October 2022.
39. Workshop to Identify Convergent Nanotechnology Approaches for Precision Delivery of Active Agents in Plants. Carnegie Mellon University, Pittsburgh, PA, September 2022.
40. Synthetic Biology Young Speaker Series (SynBYSS). Virtual, July 2022. Award talk.

LEADERSHIP AND SERVICE (since starting at Caltech)

Jacobs Institute for Molecular Engineering for Medicine, <i>Steering Committee Member</i>	2024-present
The Plant Cell Atlas (PCA) Synthetic Biology Committee Member	2024-present

Conference/Workshop Chair and Organizing Committee Member

- 2025 DOE BER Workshop "Plant Design for a Developing Bioeconomy" **Co-Chair**
- 2025 Synthetic Biology: Engineering, Evolution & Design (SEED2025) – Organizing Committee Member
- 2024 International Conference on Biomolecular Engineering (ICBE) **Co-Chair**
- 2024 SynBYSS: Synthetic Biology Young Speaker Series – Organizing Committee Member
- 2023 Synthetic Biology: Engineering, Evolution & Design (SEED2023) – Organizing Committee Member
- 2022 32nd International Conference on Arabidopsis Research (ICAR2022) – Organizing Committee Member
- 2022 *In Vitro* Biology Meeting (SIVB2022) – Organizing Committee Member

Conference/Workshop Participant

- 2025 DARPA Synthetic Biology Workshop Participant
- 2025 University of Florida Plant SynBio Workshop Participant
- 2025 The Spirit of Asilomar and the Future of Biotechnology Participant
- 2024 EBRC Space Health Roadmap Workshop Participant
- 2023 DOE Plant Transformation Workshop Participant

Conference Session Chair/Co-Chair

- 2024 ECS Session Chair: Carbon Nanostructures in Medicine and Biology Symposium
- 2024 ACS BIOT Session Chair: Synthetic Biology and Genome Engineering
- 2023 SEED2023 Chair: Synthetic Biology for Climate and Environment Sustainability
- 2022 AIChE Annual Meeting, Co-Chair: Cell-free systems and DNA assembly platforms
- 2022 *In Vitro* Biology Meeting (SIVB), Chair: Novel Delivery Technologies - Overcoming Bottleneck
- 2022 ECS Spring Meeting, Chair: Carbon Nanostructures in Medicine and Biology Symposium

Journal Editorial

Editor at Wiley for the book *Smart Nanocarriers for Plants: Design, Transport, and Applications*

2025-present

Advisory Board Member at *ACS Synthetic Biology*

2023-present

Advisory Board Member at *GEN Biotechnology*

2021-present

Topic Editor at *Frontiers in Genome Editing*, Genome Editing in Plants

2021-2023