

Taek Soon Lee

Director of Metabolic Engineering, Fuels Synthesis Division
Joint BioEnergy Institute, Lawrence Berkeley National Laboratory
and
Biological Systems and Engineering Division, Lawrence Berkeley National Laboratory

5885 Hollis Street
Emeryville, CA 94608
Tel: 510-495-2469
E-mail: tslee@lbl.gov

EDUCATION

- 2001-2006 Ph.D., Chemistry, Stanford University, Stanford, CA
Advisor: Professor Chaitan Khosla
Dissertation title: *Synthetic and Biosynthetic Studies Toward Novel Aromatic Polyketides*
- 1998-1999 Masters program participant at Seoul National University.
Organic Chemistry, Seoul National University, Seoul, Korea
Advisor: Professor Junghun Suh and Professor Myunghyun Paik Suh
- 1994-1998 B.S. (*summa cum laude*), Chemistry, Seoul National University, Seoul, Korea

EXPERIENCE

- 2012-current Research Scientist, Physical Biosciences Division, Lawrence Berkeley Laboratory
Director of Metabolic Engineering, Fuels Synthesis Division, Joint BioEnergy Institute, Emeryville, CA
- 2009-2012 Project Scientist, Physical Biosciences Division, Lawrence Berkeley Laboratory
Director of Metabolic Engineering, Fuels Synthesis Division, Joint BioEnergy Institute, Emeryville, CA
- 2008-2009 Project Scientist, Physical Biosciences Division, Lawrence Berkeley Laboratory
Deputy Director of Metabolic Engineering, Fuels Synthesis Division, Joint BioEnergy Institute, Emeryville, CA
- 2008-2008 Postdoctoral researcher, Physical Biosciences Division, Lawrence Berkeley Laboratory, Joint BioEnergy Institute, Emeryville, CA
- 2006-2007 Postdoctoral researcher, University of California, Berkeley, CA
- 2002-2006 Research assistant, Stanford University, Stanford, CA
- 2001-2002 Teaching assistant, Stanford University, Stanford, CA
- 1999-2001 Military service as Korean Augmentation to the US Army (KATUSA)
- 1998-1999 Teaching assistant, Seoul National University, Seoul, Korea
- 1997-1998 Undergraduate research assistant with Professor Junghun Suh, Seoul National University, Seoul, Korea

AWARD

- 2013 JBEI Industry Relationship Award
- 2003-2004 Boehringer Ingelheim Graduate Fellowship

PUBLICATIONS

1. Eudes, A., Teixeira Benites, V., Wang, G., Baidoo, E.E., **Lee, T.S.**, Keasling, J.D., Loqué, D., Precursor-directed combinatorial biosynthesis of cinnamoyl, dihydrocinnamoyl, and benzoyl anthranilates in *Saccharomyces cerevisiae*. *PLoS One*. **2015**, 10(10), e0138972 (doi: 10.1371/journal.pone.0138972)
2. Beller, H.R., **Lee, T.S.**, Katz, L., Natural products as biofuels and bio-based chemicals: fatty acids and isoprenoids. *Nat. Prod. Rep.* **2015**, 32, 1508-1526 (doi: 10.1039/c5np00068h)
3. George, K.W., Thompson, M.G., Kang, A., Baidoo, E., Wang, G., Chan, L.J.G., Petzold, C.J., Adams, P.D., Keasling, J.D., **Lee, T.S.**, Metabolic engineering for the high-yield production of isoprenoid-based C5 alcohols in *E. coli*, *Sci. Rep.* **2015**, 5, 11128 (doi: 10.1038/srep11128)
4. Chubukov, V., Mingardon, F., Schackwitz, W., Baidoo, E.E., Alonso-Gutierrez, J., Hu, Q., **Lee, T.S.**, Keasling, J.D., Mukhopadhyay, A., Acute limonene toxicity in *Escherichia coli* is caused by limonene-hydroperoxide and alleviated by a point mutation in alkyl hydroperoxidase (AhpC)., *Appl. Environ. Microbiol.* **2015**, (doi: 10.1128/AEM.01102-15)
5. Shi, J., George, K.W., Sun, N., He, W., Li, C., Stavila, V., Keasling, J.D., Simmons, B.A., **Lee, T.S.**, Singh, S., Impact of pretreatment technologies on saccharification and isopentenol fermentation of mixed lignocellulosic feedstocks, *BioEnergy Research* **2015**, 1-10. (doi: 10.1007/s12155-015-9588-z)
6. George, K.W., Alonso-Gutierrez, J., Keasling, J.D., **Lee, T.S.**, Isoprenoid drugs, biofuels and chemicals - artemisinin, farnesene and beyond (review), *Adv Biochem Eng Biotechnol.* **2015** (doi: 10.1007/10_2014_288)
7. Alonso-Gutierrez, J., Kim, E.M., Batth, T.S., Cho, N., Hu, Q., Chan, L.J.G., Petzold, C.J., Hillson, N.j., Adams, P.D., Keasling, J.D., Garcia-Martin, H., **Lee, T.S.**, Principal component analysis of proteomics (PCAP) as a tool to direct metabolic engineering. *Metabol. Eng.* **2015**, 28, 123-133 (doi: 10.1016/j.ymben.2014.11.011)
8. Foo, J.L., Jensen, H.M., Dahl, R.H., George, K., Keasling, J.D., **Lee, T.S.**, Leong, S., Mukhopadhyay, A., Improving Microbial Biogasoline Production in *Escherichia coli* Using Tolerance Engineering, *mBio*, **2014**, 5, e01932 (doi: 10.1128/mBio.01932-14)
9. Rotavera, B., Zádor, J., Welz, O., Sheps, L., Scheer, A.M., Savee, J.D., Akbar Ali, M., **Lee, T.S.**, Simmons, B.A., Osborn, D.L., Violi, A., Taatjes, C.A., Photoionization mass spectrometric measurements of initial reaction pathways in low-temperature oxidation of 2,5-dimethylhexane, *J. Phys. Chem. A*, **2014**, 118, 10188-200
10. Goh, E.B., Baidoo, E.E., Burd, H., **Lee, T.S.**, Keasling, J.D., Beller, H.R. Substantial improvements in methyl ketone production in *E. coli* and insights on the pathway from in vitro studies, *Metabol. Eng.*, **2014**, 26, 67-76 (doi: 10.1016/j.ymben.2014.09.003)
11. Kang M.K., Lee, J., Um, Y., **Lee, T.S.**, Bott, M., Park, S.J., Woo, H.M. Synthetic biology platform of CoryneBrick vectors for gene expression in *Corynebacterium glutamicum* and its application to xylose utilization, *Appl Microbiol Biotechnol.*, **2014**, 98, 5991-6002 (doi: 10.1007/s00253-014-5714-7)
12. Rüegg, T., Kim, E.M., Simmons, B.A., Keasling, J.D., Singer, S., **Lee, T.S.**, Thelen, M., An auto-inducible mechanism for ionic liquid resistance in microbial biofuel production, *Nature Communications*, **2014**, (doi: 10.1038/ncomms4490)
13. George, K.W., Chen, A., Jain, A., Batth, T.S., Baidoo, E., Wang, G., Adams, P.D., Petzold, C.J., Keasling, J.D., **Lee, T.S.**, Correlation analysis of targeted proteins and metabolites to assess and engineer microbial isopentenol production, *Biotech. Bioeng.* **2014**, 111, 1648-1658 (doi:10.1002/bit.25226)
14. Mack, J.H., Rapp, V.H., Broeckelmann, M., **Lee, T.S.**, Dibble, R.W., Investigation of Biofuels from Microorganism Metabolism for Use as Anti-Knock Additives, *Fuel*, **2014**, 117, 939-943 (doi: 10.1016/j.fuel.2013.10.024)

15. Dahl, R.H., Zhang, F., Alonso-Gutierrez, J., Baidoo, E., Batth, T.S., Redding-Johanson, A.M., Petzold, C.J., Mukhopadhyay, A., **Lee, T.S.**, Adams, P.D., Keasling, J.D., Engineering dynamic pathway regulation using stress-response promoters. *Nature Biotech.* **2013**, *31*, 1039-46 (doi: 10.1038/nbt.2689)
16. Alonso-Gutierrez, J., Chan, R., Batth, T.S., Adams, P.D., Keasling, J.D., Petzold, C.J., **Lee, T.S.**, Metabolic engineering of *Escherichia coli* for limonene and perillyl alcohol production. *Metabol. Eng.* **2013**, *19*, 33-41 (doi: 10.1016/j.ymben.2013.05.004)
17. Woo, H.M., Murray, G.W., Batth, T. S., Prasad, N., Adams, P.D., Keasling, J.D., Petzold, C.J., **Lee, T.S.**, Application of targeted proteomics and biological parts assembly in *E. coli* to optimize the biosynthesis of an anti-malarial drug precursor, amorpha-4,11-diene. *Chem. Eng. Sci.* **2013**, *103*, 21-28 (doi: 10.1016/j.ces.2013.04.033)
18. Müller, J., Maceachran, D., Burd, H., Sathitsuksanoh, N., Bi, C., Yeh, Y.C., **Lee, T.S.**, Hillson, N.J., Chhabra, S.R., Singer, S.W., Beller, H.R.. Engineering of *Ralstonia eutropha* H16 for Autotrophic and Heterotrophic Production of Methyl Ketones. *Appl. Environ. Microbiol.* **2013**, *79*, 4433-4439
19. Bokinsky, G., Baidoo, E.E., Akella, S., Burd, H., Weaver, D., Alonso-Gutierrez, J., García-Martín, H., **Lee, T.S.**, Keasling, J. D. HipA-triggered growth arrest and β -lactam tolerance in *Escherichia coli* is mediated by RelA-dependent ppGpp synthesis. *J. Bacteriol.* **2013**, *195*, 3173-3182
20. Ozaydin, B., Burd, H., **Lee, T.S.**, Keasling, J.D., Carotenoid-based Phenotypic Screen of the Yeast Deletion Collection Reveals New Genes with Roles in Isoprenoid Production. *Metabol. Eng.* **2013**, *15*, 174-183 (doi: 10.1016/j.ymben.2012.07.010)
21. Satoh, Y., Tajima, K., Munekata, M., Keasling, J.D., and **Lee T.S.**, Engineering of L-tyrosine oxidation in *Escherichia coli* and microbial production of hydroxytyrosol. *Metabol. Eng.* **2012**, *14*, 603-610 (doi: 10.1016/j.ymben.2012.08.00)
22. Park, J.I., Steen, E.J., Burd, H., Evans, S.S., Redding-Johnson, A.M., Batth, T., Benke, P.I., D'haeseleer, P., Sun, N., Sale, K.L., Keasling, J.D., **Lee, T.S.**, Petzold, C.J., Mukhopadhyay, A., Singer, S.W., Simmons, B.A., Gladden, J.M., A thermophilic ionic liquid-tolerant cellulase cocktail for the production of cellulosic biofuels. *PLoS One.* **2012**, *7*(5), e37010
23. Deng, K., George, K.W., Reindl, W., Keasling, J.D., Adams, P.D., **Lee, T.S.**, Singh, A.K., Northen, T.R., Encoding substrates with mass tags to resolve stereospecific reactions using Nimzyme. *Rapid Commun. Mass Spectrom.* **2012**, *26*(6):611-5. doi: 10.1002/rcm.6134.
24. Welz, O., Zador, J., Savee, J.D., Ng, M.Y., Meloni, G., Fernandes, R.X., Sheps, L., Simmons, B.A., **Lee, T.S.**, Osborn, D.L., and Taatjes, C.A., Low-Temperature Combustion Chemistry of Biofuels: Pathways in the Initial Low-Temperature (550 K - 750 K) Oxidation Chemistry of Isopentanol. *Phys. Chem. Chem. Phys.* **2012**, doi: 10.1039/C2CP23248K.
25. Satoh, Y., Tajima, K., Munekata, M., Keasling, J.D., and **Lee T.S.**, Engineering of a Tyrosol-Producing Pathway, Utilizing Simple Sugar and the Central Metabolic Tyrosine, in *Escherichia coli*. *J. Agric. Food Chem.* **2012**, *60*, 979-84 (doi: 10.1021/jf203256f)
26. Bokinsky, G., Peralta-Yahya, P.P., George, A. Holmes, B.M., Steen, E.J., Dietrich, J., **Lee, T.S.**, Tullman-Ercek, D., Voigt, C.A., Simmons, B.A., and Keasling, J.D., Synthesis of three advanced biofuels from ionic liquid-pretreated switchgrass using engineered *Escherichia coli*. *PNAS* **2011**, *108*, 19949-54 (doi: 10.1073/pnas.1106958108)
27. **Lee, T. S.**, Krupa, R., Zhang, F., Hajimorad, M., Holtz, W.J., Prasad, N., Lee, S.K., and Keasling, J.D., BglBrick vectors and datasheets; a synthetic biology platform for gene expression. *J. Biol. Eng.* **2011**, *5*:12, (doi:10.1186/1754-1611-5-12)
28. Peralta-Yahya, P.P., Ouellet, M., Chan, R., Mukhopadhyay, A., Keasling, J.D., and **Lee,**

- T.S.**, Identification and microbial production of a terpene-based advanced biofuel. *Nature Communications* **2011**, 2: 483 (doi: 10.1038/ncomms1494)
29. Ma, S.M., Garcia, D.E., Redding-Johanson, A.M., Friedland, G.D., Chan, R., Batth, T.S., Haliburton, J.R., Chivian, D., Keasling, J.D., Petzold, C.J., **Lee, T.S.**, and Chhabra, C.R., Optimization of a heterologous mevalonate pathway through the use of variant HMG-CoA reductases. *Metabol. Eng.* **2011**, 13, 588-597.
 30. Dunlop, M.J., Dossani, Z.Y., Szmids, H.L., Chu, H.C., **Lee, T.S.**, Keasling, J.D., Hadi, M.Z., Mukhopadhyay, A. Engineering microbial biofuel tolerance and export using efflux pumps. *Mol. Syst. Biol.* **2011**, 7: 487
 31. Redding-Johanson, A.M., Batth, T.S., Chan, R., Krupa, R., Szmids, H.L., Adams, P.D., Keasling, J.D., **Lee, T.S.**, Mukhopadhyay, A., Petzold, C.J. Targeted proteomics for metabolic pathway optimization: Application to terpene production. *Metabol. Eng.* **2011**, 13, 194-203.
 32. Lee, S.K., Chou, H., Ham, T.S., **Lee, T.S.**, Keasling, J.D. Metabolic engineering of microorganisms for biofuels production: from bugs to synthetic biology to fuels. *Curr. Opin. Biotechnol.* **2008**, 19, 556-563
 33. Fortman, J.L., Chhabra, S., Mukhopadhyay, A., Chou, H., **Lee, T.S.**, Steen, E., Keasling, J.D. Biofuel alternatives to ethanol: pumping the microbial well. *Trends. Biotech.* **2008**, 26, 375-381
 34. **Lee, T.S.**, Das, A., Khosla, C. Structure-activity relationships of semisynthetic mumbaistatin analogs. *Bioorg. Med. Chem.* **2007**, 15, 5207-5218
 35. **Lee, T.S.**, Khosla, C., Tang, Y. Orthogonal protein interactions in spore pigment producing and antibiotic producing polyketide synthases. *J. Antibiotics*, **2005**, 58, 663-666
 36. **Lee, T.S.**, Khosla, C., Tang, Y. Engineered biosynthesis of aklanonic acid analogs. *J. Am. Chem. Soc.* **2005**, 127, 12254-12262
 37. Tang, Y., **Lee, T.S.**, Lee, H., Khosla, C. Exploring the biosynthetic potentials of bimodular aromatic polyketide synthases. *Tetrahedron*, **2004**, 60, 7659-7671
 38. Tang, Y., **Lee, T.S.**, Khosla, C. Engineered biosynthesis of regioselectively modified aromatic polyketides using bimodular polyketide synthases. *Public Library of Science-Biology*, **2004**, 2, 227-238.
 39. Tang, Y., **Lee, T.S.**, Kobayashi, S., Khosla, C. Ketosynthases in the initiation and elongation modules of aromatic polyketide synthases have orthogonal acyl carrier protein specificity. *Biochemistry* **2003**, 42, 6588-6595.
 40. Choi, H.J., **Lee, T.S.**, Suh, M.P. Selective binding of open frameworks assembled from nickel(II) macrocyclic complexes with organic and inorganic guests. *J. Inclusion Phenom. Macrocyclic Chem.* **2001**, 41, 155-162.
 41. Choi, H.J., **Lee, T.S.**, Suh, M.P. Self-assembly of a molecular floral lace with one-dimensional channels and inclusion of glucose. *Angew. Chem., Int. Ed.* **1999**, 38, 1405-1408.

PATENTS

1. **Lee, T.S.**, Kang, A., Novel Host Cells and Methods for Producing Isopentenol from Mevalonate, U.S. Patent Application Ser. No: 62/119,071
2. **Lee, T.S.**, Satoh, Y., Keasling, J.D., Host cells and methods for oxidizing aromatic amino acids, PCT/US2012/031025
3. **Lee, T.S.**, Peralta-Yahya, P. Keasling, J.D., Isoprenoid based alternative diesel fuel, PCT/US2011/059784
4. **Lee, T.S.**, Fortman, J.L., Keasling, J.D., Host cells and methods for producing isoprenyl alkanolates. PCT/US2010/0180491

BOOKCHAPTERS

1. Woo, H.M., **Lee, T.S.**, Chapter 6. Isoprene-derived biofuels from engineered microbes, *Biofuels: From Microbes to Molecules*, Caister Academic Press (2014)
2. Kang, A., **Lee, T.S.**, Chapter 2. Secondary metabolism for isoprenoid-based biofuels, *Biotechnologies for Biofuel Production and Optimization*, Elsevier (2015)

PRESENTATIONS

1. Lee, T.S., Kang, A. et al. Advanced pathways for microbial production of branched C₅ alcohols. Terpnet 2015, Vancouver, Canada, Jun 1-5, 2015. (poster)
2. Lee, T.S. Microbial production of advanced biofuels. Seoul National University, Chemistry Department Seminar, Seoul, Korea, May 14, 2015. (invited)
3. Lee, T.S. Microbial production of advanced biofuels. Kunkuk University, Bioscience and Biotechnology Department Seminar, Seoul, Korea, May 11, 2015. (invited)
4. Lee, T.S. Microbial production of advanced biofuels. National University of Singapore, Biochemistry Department Seminar, Singapore, May 6, 2015. (invited)
5. Lee, T.S. Advanced pathways for microbial production of branched C₅ alcohols. 249th ACS National Meeting & Exposition, Denver, CO, March 22-26, 2015. (oral presentation)
6. Lee, T.S. Microbial production of advanced biofuels. UC Davis Chemistry Department Seminar, Davis, CA, February 10, 2015. (invited)
7. Lee, T.S. Joint Efforts for Biomass to Biofuel Researches - the Joint BioEnergy Institute (JBEI). KOLIS (Korean Life Scientist in the SF Bay Area) Winter Conference, San Francisco, CA, December 6, 2014. (invited plenary talk)
8. Lee, T.S. Joint Efforts for Biomass to Biofuel Researches - the Joint BioEnergy Institute (JBEI). US-Korea Conference (UKC), San Francisco, CA, August 7-9, 2014. (invited talk)
9. Lee, T.S. Balancing heterologous pathway - dynamic regulation of the pathway and Proteomics/Production analysis. Society for Industrial Microbiology Annual Meeting, St. Louis, MO, July 20-24, 2014. (invited talk)
10. Lee, T.S. Sesquiterpene (C₁₅) biofuel production: From synthetic biology to scale-up. 247th ACS National Meeting & Exposition, Dallas, TX, March 16-20, 2014. (oral presentation)
11. Lee, T.S. Proteomics-aided correlation analysis of the isoprenoid pathway for C₅ alcohol production in *E. coli*. Society for Industrial Microbiology Annual Meeting, San Diego, CA, 2013 (invited talk).
12. Lee, T.S. Microbial production of advanced biofuels – C₅ alcohols. 245th ACS National Meeting & Exposition, New Orleans, LA, April 7-11, 2013. (oral presentation)
13. Lee, T.S. Microbial production of a terpene-based advanced biofuels. 243rd ACS National Meeting & Exposition, San Diego, CA, March 25-29, 2012. (oral presentation)
14. Lee, T.S. Biocatalysis - Microbial engineering for advanced biofuel production, 5th GCOE International Symposium, Hokkaido University, Japan, Feb 21-22, 2012 (invited talk)
15. Lee, T.S. Microbial production of isoprenoid-based biofuel. Society for Industrial Microbiology Annual Meeting, New Orleans, LA, 2011 (invited talk).
16. Lee, T.S., Satoh, Y., Keasling, J.D., Engineered biosynthesis of hydroxytyrosol, a potent antioxidant from olive, 241st ACS National Meeting & Exposition, Anaheim, CA, March 27-31, 2011. (oral presentation)
17. Lee, T.S., Johanson, A., Ma, S., Friedland, G., Haliburton, J., Chan, R., Batth, T., Mckee, A., Chivian, D., Keasling, J.D., Petzold, C., and Chhabra, S.R. Evaluation of HMG-CoA Reductase variants for improved isoprenoid production in *Escherichia coli*, 241st ACS National Meeting & Exposition, Anaheim, CA, March 27-31, 2011. (oral presentation)

- presentation)
18. Lee, T.S. "JBEI Fuels Synthesis - Metabolic Engineering of Isoprenoid Biofuel Pathway", AIChE Annual Meeting, Salt Lake City, UT, November 12, 2010 (invited talk).
 19. Lee, T.S. Synthetic biology toward metabolic engineering of mevalonate pathway. Society for Industrial Microbiology Annual Meeting, San Francisco, CA, 2010 (invited talk).
 20. Lee, T.S., Krupa, Hajimorad, Prasad, Lee, Keasling. "Biobrick vectors and datasheets; a synthetic biology platform for metabolic engineering" (poster) ACS National Meeting, San Francisco., March 21-25, 2010
 21. Lee, T.S., Chan, Keasling. "Metabolic engineering of mevalonate pathway" (poster) ACS National Meeting, San Francisco., March 21-25, 2010
 22. Lee, T.S., Lee, S.K., Keasling, J.D. Studies for the production of benzyloquinoline alkaloids in metabolically engineered *Escherichia coli* strains. Society for Industrial Microbiology Annual Meeting, San Diego, CA, 2008 (invited talk)

COMMUNITY SERVICE

Editorial Board Member of Scientific Reports, Frontiers in Synthetic Biology

Reviewer of ACS Synthetic Biology, Metabolic Engineering, Biotechnology for Biofuel, Biotechnology and Bioengineering, Biotechnology Journal, BMC Systems Biology, Chemical Engineering Science, Molecular Biotechnology

Institutional Biosafety Committee (IBC) member at Lawrence Berkeley National Laboratory

MEMBERSHIPS

American Chemical Society
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MENTORING AND POSTGRADUATE-SCHOLAR SPONSOR

Current: Jorge Alonso-Gutierrez (2010-Now), Project scientist; Aram Kang (2013-Now), Postdoctoral associate; Daniel Mendez (2015-Now), Postdoctoral associate; Corey Meadows (2015-Now), Postdoctoral associate; Erika Yoshida (2014-Now), Visiting scientist; Daisuke Koma (2015-Now), Visiting scientist; Brad Niles (2015-Now), Scientist from industry; Florence Mingardon (2015-Now), Scientist from industry

Past: Han Min Woo (2010-2011, Postdoctoral associate), now Sr. Staff Scientist at Korea Institute of Science and Technology, Korea; Yasuharu Satoh (2010-2011, Visiting scientist) now Assistant professor at Hokkaido University, Japan; Eun-Mi Kim (2011-2013, Postdoctoral associate) now postdoc at Korea Institute of Science and Technology, Korea; Kevin George (2010-2014, Postdoctoral associate) now Scientist at Amyris; Rachel Krupa (2008-2009, Research associate II); Nilu Prasad (2008-2010, Research associate II); Rossana Chan (2008-2012, Research associate II); Veronica Fok (2008-2013, Research associate II); Gregory Murray (2011-2013, Research associate I), now at Ph.D. program at University of Notre Dame; Helcio Burd (2012-2014, Senior Research Associate (SRA-IV)); Nicolas Canu (2015-2015), Visiting Intern Student; Margaux Molinas (2015-2015), Visiting Intern Student