Mohamad Abedi

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RESEARCH INTERESTS

Synthetic biology, Computational protein engineering and Cell therapies

EDUCATION

California Institute of Technology, Pasadena Ph.D. in Bioengineering, Feb 2021
Thesis: Protein engineering for imaging and control of cell therapies deep inside the body

University of California, Irvine B.S in Biomedical Engineering*, June 2014
*Acquired a specialization in Micro and Nano biomedical engineering

Irvine Valley Community College, Irvine Engineering, June 2011

RESEARCH EXPERIENCE

Institute for Protein Design, *Prof: David Baker* HHMI/JCC fellow, UW, Seattle
April, 2021— current

Research Project: Decoding the cell signaling space by building agonists from the bottom up.

- *Established hybrid pipeline that combines machine learning with automation to rapidly build and screen* agonists.
- *Established a methodology to rapidly sample receptor geometries to tune natural and synthetic cytokine signaling*

Research Project: Building orthogonal communication networks

- *Established an orthogonal communication network in mammalian cells with de novo designed proteins.*
- *Demonstrated the utility of this technology in primary human T cells.*

Research Project: Targeted Viral delivery in vivo

- *Established a strategy to modify specific cellular subsets by combining viral engineering with protein logic circuits.*
- *Demonstrated the ability of this technology to edit cells in vivo.*

Research Project: Design endocytosis-triggering proteins mediate targeted degradation

- *Established a protein-based strategy to degrade receptors.*
- *Integrated the degradation technology with protein-logic to target specific cellular subsets.*

Laboratory of Non-Invasive Biological Interactions, *Prof: Mikhail Shapiro* Caltech, Ph.D
August, 2014— February, 2021

Research Project: Engineering tools to enable thermal control cell-based therapies

- *Engineered a new class of robust, sharp and tunable thermal bioswitches in microbes.*
- *Integrated thermal bioswitches into tumor homing bacteria for spatiotemporal control over bacterial therapy.*
- *Incorporated heat shock promoters into genetic circuits to allow for enhanced control of T-cell immunotherapy.*

PUBLICATIONS

* = Equal contribution

1. Susana Vazquez Torres, Melisa Benard Valle, ... **Abedi, M. H.,** ..., David Baker. " De novo designed proteins neutralize lethal snake venom toxins." *Research Square* (2024)
2. Erin C Yang, Robby Divine, Marcos C Miranda, Andrew J Borst, Will Sheffler, ... **Abedi, M. H.,** ..., David Baker. "Computational design of non-porous pH-responsive antibody nanoparticles." *Nature Structural & Molecular Biology* (2024)
3. Buwei Huang*, **Abedi, M. H. *,** Green Ahn*, Brian Coventry*, ...David Baker."Designed endocytosis-triggering proteins mediate targeted degradation." *BioRxiv* (2023)
4. Motmaen, Amir, Justas Dauparas, Minkyung Baek, **Abedi, M. H.,** David Baker, and Philip Harlan Bradley. "Peptide binding specificity prediction using fine-tuned protein structure prediction networks." *PNAS* (2023)
5. Hurt, R. C., Buss, M. T., Duan, M., Wong, K., You, M. Y., Sawyer, D. P., ... **Abedi, M. H.,** & Shapiro, M. G. "Genomically mined acoustic reporter genes for real-time in vivo monitoring of tumors and tumor-homing bacteria." *Nature Biotechnology* (2023): 1-13.
6. **Abedi, M. H.***, Michael S. Yao*, David R. Mittelstein, Avinoam Bar-Zion, Margaret B. Swift, Audrey Lee-Gosselin, Pierina Barturen-Larrea, Marjorie T. Buss, and Mikhail G. Shapiro. "Ultrasound-controllable engineered bacteria for cancer immunotherapy." *Nature Communications* 13, no. 1 (2022): 1585.
7. Bar-Zion, Avinoam, Atousa Nourmahnad, David R. Mittelstein, Shirin Shivaei, Sangjin Yoo, Marjorie T. Buss, Robert C. Hurt, **Abedi, M. H.** et al. "Acoustically triggered mechanotherapy using genetically encoded gas vesicles." *Nature nanotechnology* 16, no. 12 (2021): 1403-1412.
8. **Abedi, M. H.,** Lee, J., Piraner, D. I., & Shapiro, M. G." Thermal Control of Engineered T-cells" *ACS Synthetic biology* (2020).
9. Maresca, D., Lakshmanan, A., **Abedi, M.**, Bar-Zion, A., Farhadi, A., Lu, G.J., Szablowski, J.O., Wu, D., Yoo, S. and Shapiro, M.G."Biomolecular Ultrasound and Sonogenetics." *Annual review of chemical and biomolecular engineering* (2018): 229-252.
10. Piraner, D. I*., **Abedi, M. H.***, Moser, B. A., Lee-Gosselin, A., & Shapiro, M. G."Tunable thermal bioswitches for in vivo control of microbial therapeutics." *Nature chemical biology* 13.1 (2017): 75.

Patents:

1. Shapiro, M.G., Piraner, D.I., **Abedi, M.H.**, Moser, B. and Audrey, L.G. "Thermal bioswitches and related genetic circuits, vectors, cells, compositions, methods and systems." U.S. Patent App No. 15/384,254.
2. **Abedi, M.H.**, Shapiro, M.G., Piraner, Lee, J. "Thermal control of t-cell immunotherapy through molecular and physical actuation." U.S. Patent App No. 63/010,525.
3. **Abedi, M.H.**, Shapiro, M.G., Yao, M. S." Acoustic remote control of microbial immunotherapy." U.S. Patent App No. 63/160,152.
4. Abdullah S Farooq, **Abedi, M.H.**, Mikhail G Shapiro, Ann Liu." Thermal state switches in macrophages." U.S. Patent App No. 17/937,614.

HONORS AND AWARDS

- HHMI Fellow of The Jane Coffin Childs Fund (2021-2024)
- Invited to an official dinner at the white house with President Barack Obama (2015)
- Paul & Daisy Soros fellowship for new Americans, Fellow (2015-2018)
- Recognized by President Barack Obama during the UC Irvine commencement ceremony, (2014)
- National Science Foundation Graduate Research Fellowship, Fellow (2014-2019)
- The Henry Samueli Endowed Scholarship, Recipient (2013)
- Edwards Life sciences Summer Undergraduate Research fellowship (2013)

MEDIA COVERAGE

- Biologists Give Bacteria Thermostat Controls, Caltech Website, Nov. 2016
- Abedi Receives Fellowship for New Americans, Caltech Website, April. 2015
- President Barack Obama Recognition Video, *Youtube*, Jun. 2014

CONFERENCE PRESENTATIONS

Oral presentations:

1. **Abedi, M. H.**, Lee, J., Piraner, D. I., & Shapiro, M. G." Thermal Control of Engineered T-cells" International Mammalian Synthetic Biology Workshop; 2020 December; Virtual.
2. **Abedi, M. H.**, Lee, J., Piraner, D. I., & Shapiro, M. G." Thermal Control of Engineered T-cells" 3rd Cell Therapies and Immunotherapy Conference, Virtual, Dec. 2020.
3. **Abedi, M. H.**, Piraner, D. I., Moser, B. A., Lee-Gosselin, A., & Shapiro, M. G "Tunable Thermal Bioswitches for In Vivo Control of Microbial Therapeutics" Biomedical Engineering Society (BMES), Minneapollis, MN, Oct. 2016.
4. **Abedi, M. H.**, Piraner, D. I., Moser, B. A., Lee-Gosselin, A., & Shapiro, M. G "Tunable Thermal Bioswitches for In Vivo Control of Microbial Therapeutics" MicroMorning, Pasadena, Ca, Jun. 2016.

Poster presentations:

1. **Abedi, M. H.**, Exposit, M., Jane, S. A., … Baker, D. "Machine Learning-Guided Design of Natural and Synthetic Cytokines" International Cytokine & Interferon Society (ICIS), Athens, Greece, October. 2023.
2. **Abedi, M. H.**, Piraner, D. I., Moser, B. A., Lee-Gosselin, A., & Shapiro, M. G "Tunable Thermal Bioswitches for Noninvasive Genetic Regulation" Synthetic Biology: Engineering, Evolution & Design (SEED), Chicago, IL, July. 2016.
3. **Abedi, M. H.**, Piraner, D. I., Moser, B. A., Lee-Gosselin, A., & Shapiro, M. G "Tunable Thermal Bioswitches for Control of Cell Function" 10th Annual Salk Institute, Fondation IPSEN, and Science Symposium on Biological Complexity: Synthetic Biology, San Diego, CA, Jan. 2016.
4. **Abedi, M. H.**, Piraner, D. I., & Shapiro, M. G "Molecular Engineering for Non-invasive Imaging and Control of Biological Function" 2nd Mammalian Synthetic Biology Workshop, Boston, MA, Apr. 2015.
5. **Abedi, M. H.**, Hui, Elliot "*Highly sensitive cardiac troponin I detection using a pneumatically controlled diagnostic chip*" Edwards Lifesciences conference, Irvine, CA, 2012 **(awarded 2nd Place)**

TEACHING

1. Teaching Assistant, **Transport Phenomena** (ChE 103B), Department of Chemistry & Chemical Engineering, Caltech, Winter 2016
2. Tutor, **STEM subjects**, Irvine Valley College, (2010-2011)