

---

## BIOGRAPHICAL SKETCH

---

NAME: Lina Freage

eRA COMMONS USER NAME (credential, e.g., agency login): FREAGEL

POSITION TITLE: Postdoctoral Researcher

---

INSTITUTION AND LOCATION	DEGREE	START DATE MM/YYYY	END DATE MM/YYYY	FIELD OF STUDY
The Hebrew University of Jerusalem, Dept. of Chemistry, Jerusalem, Israel.	B.Sc	10/2009	10/2012	Chemistry, with Subdivision in Biology
The Hebrew University of Jerusalem, Dept. of Chemistry, Jerusalem, Israel.	M.Sc.	10/2012	10/2014	Organic Chemistry
The Hebrew University of Jerusalem, Dept. of Chemistry, Jerusalem, Israel.	Ph.D.	10/2014	04/2018	Organic Chemistry
NYU Langone Medical Center, Dept. of Biochemistry and Mol. Pharmacology, NY	Postdoctoral	05/2018	12/2018	Biochemistry
City University of New York (CUNY), Dept. of Chemistry, NY	Postdoctoral	12/2018	Present	Bioanalytical Chemistry

### A. Personal Statement

The driving focus of my studies and research has always been the interfaces of biology, chemistry, and materials sciences to address fundamental questions. This combination of fields and significance of work defines my interest in Professor Mallikaratchy's laboratory. Based on my background, training, and interests, I found that Professor Mallikaratchy's lab provides a rich environment where I could contribute from my background while growing new experience and skill sets in the development of immunotherapies and cell-cell interactions. I bring to the lab a knowledge of DNA design, and with this I plan to address new research directions in using

aptamers control cell-cell interaction. I believe cell-targeting aptamers are a powerful tool for elucidating fundamental mechanism in immune therapy.

During my doctoral research, I was engaged in research regarding the design, synthesis, and characterization of DNA-based systems, with a focus on platforms for the development of amplified and multiplexed sensors for the detection of genes, small molecules, and metal ions. In addition, I have more generally explored the potential of bio-hybrid systems, using DNA to create stimuli-responsive metal organic frameworks. These studies have provided me with broad technical experience related to biological/chemical systems and disciplines such as enzyme work, DNA sequence design, organic synthesis, synthesis of metal nanoparticles, self-assembly, and stimuli-responsive processes, as well as the analytical techniques associated with such research. Following is a list of the associated publications from my doctorate:

1.) **L. Freage**, A. Trifonov, R. Tel Vered, E. Golub, F. Wang, J. S. McCaskill and I. Willner. Addressing, amplifying and switching DNAzyme functions by electrochemically-triggered release of metal ions. *Chem. Sci.*, **2015**, 6, pp 3544-3549.

2.) **L. Freage**, F. Wang, R. Orbach and I. Willner. Multiplexed Analysis of Genes and of Metal Ions Using Enzyme/DNAzyme Amplification Machineries. *Anal. Chem.*, **2014**, 86 (22), pp 11326–11333.

3) F. Wang, **L. Freage**, R. Orbach and I. Willner. Autonomous Replication of Nucleic Acids by Polymerization/Nicking Enzyme/DNAzyme Cascades for the Amplified Detection of DNA and the Aptamer-Cocaine Complex. *Anal. Chem.*, **2013**, 85 (17), pp 8196-8203.

3.) J.S. Kahn<sup>†</sup>, **L. Freage**<sup>†</sup>, N. Enkin, M.A. Aleman-Garcia, I. Willner. Stimuli- Responsive DNA-Functionalized Metal-Organic Frameworks (MOFs). *Adv. Materials*, **2017**, 29, 1602782. († denotes equal contribution).

## **B. Positions and Honors**

### **Positions and Employment**

10/2011- 07/2012	Research Assistant, Hebrew University of Jerusalem
05/2018-12/2018	Postdoctoral Researcher, Langone Medical Center, NY
12/2018- present	Postdoctoral Researcher, Lehman Collage (CUNY), NY

### **Teaching Experience**

09/2010- 07/2013	Teaching Assistant, The Hebrew University of Jerusalem.
05/2018-12/2018	Teaching Assistant, Havat Ha-Noar School, Jerusalem.
06/2015- 05/2018	Teaching Assistant, Kfar Qasem, High School, Israel.

### **Honors**

2011	Fruchter Excellence Scholarship
2017	Dean's Scholarship

## C. Contribution to Science

1. Study of Hybrid systems and nanoscale materials, focusing on biomaterials that use nucleic acids to encode organizational and catalytic functions for sensing applications. The biosensors include the chain reaction of Polymerization/Nicking/DNAzyme cascade for highly sensitive sensors.
  - a) **L. Freage**, F. Wang, R. Orbach and I. Willner. Multiplexed Analysis of Genes and of Metal Ions Using Enzyme/DNAzyme Amplification Machineries. *Anal. Chem.*, **2014**, 86 (22), pp 11326–11333
  - b) F. Wang, **L. Freage**, R. Orbach and I. Willner. Autonomous Replication of Nucleic Acids by Polymerization/Nicking Enzyme/DNAzyme Cascades for the Amplified Detection of DNA and the Aptamer-Cocaine Complex. *Anal. Chem.*, **2013**, 85 (17), pp 8196-8203.
2. Development of an "artificial cell" analogy, in which electrochemical methods are used to release metal ions that activate a hybridization chain reaction to create amplified DNA-based catalytic systems.
  - a) **L. Freage**, A. Trifonov, R. Tel Vered, E. Golub, F. Wang, J. S. McCaskill and I. Willner. Addressing, amplifying and switching DNAzyme functions by electrochemically-triggered release of metal ions. *Chem. Sci.*, **2015**, 6, pp 3544-3549.
3. Utilizing organic synthesis and implementing biosynthetic techniques to assemble metal organic frameworks (MOFs) integrated with active DNA motifs for the controlled carrying and release of substrates.
  - a) J.S. Kahn<sup>†</sup>, **L. Freage**<sup>†</sup>, N. Enkin, M.A. Aleman-Garcia, I. Willner. Stimuli- Responsive DNA-Functionalized Metal-Organic Frameworks (MOFs). *Adv. Materials*, **2017**, 29, 1602782. († denotes equal contribution).

## D. List of Publications

- 1) J. S. Kahn<sup>†</sup>, **L. Freage**<sup>†</sup>, N. Enkin, M.A. Aleman-Garcia, I. Willner. Stimuli-Responsive DNA-Functionalized Metal-Organic Frameworks (MOFs). *Adv. Materials* **2017**, 29, 1602782.
- 2) V. Heleg Shabtai, R. Aizen, E. Sharon, Y. S. Sohn, A. Trifonov, N. Enkin, **L. Freage**, R. Nechushtai and I. Willner. Gossypol-Capped Mitoxantrone-Loaded Mesoporous SiO<sub>2</sub> NPs for the Cooperative Controlled Release of Two Anti-Cancer Drugs. *ACS Appl. Mater. Interfaces* **2016**, 8 (23), pp 14414–14422.
- 3) **L. Freage**, A. Trifonov, R. Tel-Vered, E. Golub, F. Wang, J. S. McCaskill and I. Willner. Addressing, amplifying and switching DNAzyme functions by electrochemically-triggered release of metal ions. *Chem. Sci.* **2015**, 6, pp 3544-3549.
- 4) **L. Freage**, F. Wang, R. Orbach and I. Willner. Multiplexed Analysis of Genes and of Metal Ions Using Enzyme/DNAzyme Amplification Machineries. *Anal. Chem.* **2014**, 86 (22), pp 11326–11333.

5) W. Guo, X.-J. Qi, R. Orbach, C.-H. Lu, **L. Freage**, I. Mironi-Harpaz, D. Seliktar, H.-H. Yang and I. Willner. Reversible Ag<sup>+</sup>-crosslinked DNA hydrogels. *Chem. Commun.* **2014**, 50, pp 4065-4068.

6) F. Wang, C.-H. Lu, X. Liu, **L. Freage** and I. Willner. Amplified and multiplexed detection of DNA using the dendritic rolling circle amplified synthesis of DNAzyme reporter units. *Anal. Chem.* **2014**, 86 (3), pp 1614–1621.

7) F. Wang, **L. Freage**, R. Orbach and I. Willner. Autonomous Replication of Nucleic Acids by Polymerization/Nicking Enzyme/DNAzyme Cascades for the Amplified Detection of DNA and the Aptamer–Cocaine Complex. *Anal. Chem.* **2013**, 85 (17), pp 8196–8203.

†- equal contribution authorship

### **Patents**

I. Willner, F. Wang, C.-H. Lu, X. Liu, L. Freage. *Compositions, kits, uses and methods for amplified detection of an analyte.* **US Patent App.** 14/586,214, **2014**, US20150197804 A1.