

From Lab-On-a-Chip to Micro-Robot Electrically-Powered Platforms for Biomedical Applications

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Abstract

Micromotors/robots extend the reach of robotic operations to submillimeter dimensions and are becoming increasingly powerful for various tasks such as manipulation of micro/nanoscale cargo and single-cell analysis. These microrobots hold the potential further advance diagnostic testing and sample analysis with advantages of the traditional lab-on-a-chip (e.g. portability, efficiency) but overcoming current challenges (e.g. complexity, predetermined design, fluid control). Our recent findings indicated the unique advantage of use of electric fields to enable unified label-free and selective micromotor-based cargo manipulation and transport that are singularly controlled via the applied electric field [1]. In addition, we demonstrated the ability of electrically-powered metallo-dielectric Janus active particle micromotors to carry organelles/cells, electro-deform cells as a novel means of biomechanical testing, and electroporate cells for transfection of drugs/genes [2]. Adding magnetic field actuation was recently shown to enable the operation of such hybrid-powered microrobots in near-physiological media conditions required for single-cell analysis [3], while using optoelectronic control was shown [4] to enable trajectory reconfiguration, directed self-assembly and parallelized operation of many such microrobots.

[1] Y. Wu, A. Fu & G. Yossifon, *Small* 1906682, 1-12 (2020).

[2] Y. Wu, A. Fu & G. Yossifon, *PNAS* 118, 38, e2106353118 (2021).

[3] Y. Wu, S. Yakov, A. Fu & G. Yossifon, *Advanced Science* 2204931 (2022).

[4] S. S. Das & G. Yossifon, *Advanced Science* 10, 2206183 (2023).

Short Biography

Professor in the school of Mechanical Engineering and Biomedical Engineering at Tel-Aviv University and the head of the μ /nano-fluidics and robotics laboratory. Gilad completed his PhD (2008) at Tel-Aviv University, his MSc (1999) and BSc (1994, Summa Cum Laude) studies in Mechanical Engineering at the Technion, and an additional MSc (2003) in Electrical Engineering in Tel-Aviv University. Between 2007-2009 he was a postdoc research associate in the University of Notre Dame in the Chemical and Biomolecular department. Between 2009 and 2021 he was an associate professor in the faculty of Mechanical Engineering at the Technion – I.I.T and since 2021 he is a full Professor in Tel-Aviv University. His research interests lie in the area of electrokinetics in micro-/nano-fluidics, active (self-propelling) particles, micro-/nano-robots and lab-on-a-chip devices.

