# Unfixing the Electric Field Gradients:
# Active Colloids as Mobile Microelectrodes for Unified Label-Free Selective Cargo Transport

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## I. Abstract Body (up to 250 words)

Utilization of active colloids to transport both biological and inorganic cargo has been widely examined in the context of applications ranging from targeted drug delivery to sample analysis. Generally, carriers are customized to load one specific target via a mechanism distinct from that driving the transport. Here, we unify these tasks and extend loading capabilities to include on-demand selection of multiple nano/micro sized targets without the need for pre-labelling or surface functionalization. An externally applied electric field is singularly used to drive the active cargo carrier and transform it into a mobile floating electrode that can attract or repel specific targets from its surface by dielectrophoresis; enabling dynamic control of target selection, loading and rate of transport via the electric field parameters. Within the context of dielectrophoretic manipulation, that this floating electrode is mobile, essentially represents a paradigm shift relative to the current generation of electrokinetically driven devices built by photolithographic patterning, where the spatial distribution of the field-gradient is always a fixed. Comparing dielectrophoresis in these two systems, we note that the unfixed electrode is able to trap nanotargets at moderate voltages. Moreover, the active mobility which enables the carrier to travel to the target and transport it to a secondary location, simplifies the overall system by eliminating the necessity of a secondary convection mechanism commonly employed in high throughput dielectrophoretic devices to bring the target to the region of high field strength. Adding directed motion via magnetic stirring enables to develop these into building blocks for bottom-up fabrication.

## II. Image:

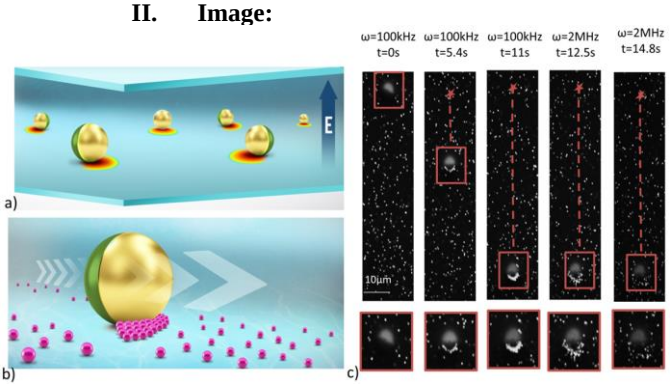



**Fig.1:** a) Schematic of the general concept of mobile microelectrode; localized gradients are induced around polarizable particle surface; b) Schematic illustrating concept of cargo transport; Janus particle picks up cargo as it translates and transports it to a secondary location; c) Microscope images showing accumulation, transport and release of 300nm target by a 15μm JP carrier controlled by the electric field frequency.

## III. Reference:

1 Abbott, N. L. and Velev, O. D. 2016. Active particles propelled into researchers' focus. Curr. Opin. Colloid Interface Sci. 21, 1–3.

2 Baraban, L. et al. 2012. Catalytic Janus Motors on Microfluidic Chip: Deterministic Motion for Targeted Cargo Delivery. ACS Nano 6, 3383–3389.

3 Boymelgreen, A. M., Balli, T., Miloh, T. and Yossifon, G. 2018. Active Colloids as Mobile Microelectrodes for Unified Label-Free Selective Cargo Transport. Nature Communications (accepted).

## IV. Biography:

Gilad Yossifon is an Associate Professor in the Faculty of Mechanical Engineering at the Technion and the head of the micro-/nano-fluidics laboratory since 2009. 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 in the University of Notre Dame in the Chemical and Biomolecular department. His research interests lie in the area of electrokinetics in micro- and nano-fluidics. He has published more than 55 papers in reputed journals.

## V. Presenting author details



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