הטכניון – מכון טכנולוגי לישראל **הפקולטה להנדסת מכונות**

סמינריון

הנך מוזמן/ת להרצאה סמינריונית של הפקולטה להנדסת מכונות, שתתקיים ביום ד' 3.08.16 (כח' בתמוז, תשע"ו), בבניין דן-קאהן, קומה 0, אודיטוריום 1, 13:30.

תרצה: אליסיה בוימלגרין

מנחה: פרופ'/ח גלעד יוסיפון

מנחה שותף: פרופ' טוביה מילוא, אוניברסיטת תל-אביב

על הנושא:

Symmetry breaking in non-linear electrokinetic colloidal transport at the micro/nanoscale

The seminar will be given in English

להלן תקציר ההרצאה:

Using a metallodielectric Janus sphere as an elemental platform for symmetry breaking, we characterize the physical mechanisms controlling its frequency dependent interaction with an externally applied electric field theoretically, experimentally and numerically. We also demonstrate the commercial potential of the Janus particle as a mobile floating electrode for dielectrophoretic applications and as an all-in-one cargo concentrator and carrier. Overall, the electrokinetic transport of Janus spheres represents a fascinating intersection of two traditionally distinct categories of colloidal motion; "self-propulsion" and field driven "phoretic motion" (-phoresis), since despite the necessary presence of the external field, the asymmetric forces driving "swimming" are produced on the particle level so that the resultant motion is akin to that of self-propelled particles – autonomous on the individual level while exhibiting group behavior at the macroscale - than the uniform migration characteristic of field-driven phoresis.

At low frequencies, Janus particles are known to align the interface between metallic and dielectric hemispheres with the electric field and travel with the dielectric hemisphere forward, due to "induced charge electrophoresis"(ICEP). By joining multiple particles, it is demonstrated that as well as linear translation, continuous rotation may be achieved, even under a uniform AC field. The orbit of the doublet and rotation speed may be controlled by relative orientation of the metallodielectric interfaces of two Janus particles.

At high frequencies, ICEP is expected to decay to zero as the electric double layer no longer has time to charge. Instead, we demonstrate that the JPs reverse direction, with a finite mobility until frequencies of MHz. Two mechanisms, which may act in tandem are proposed for this phenomena. Firstly it is shown that symmetry breaking may result in a reversal of ICEO flow which can cause backwards propulsion at moderate frequencies. Additionally, we consider the localized disturbance of the electric field by the presence of the particle, demonstrating that the asymmetry can induce local gradients, capable of driving the particle in a manner analogous to dielectrophoresis (DEP). This effect, which we have termed "self-dielectrophoresis" to emphasize that motion results from a gradient induced by the particle itself rather than the external field, is amplified when the symmetry is further broken by the proximity of the particle to the channel wall.

Finally, it is demonstrated that as well as propelling the Janus particle, the localized gradients enable trapping of nanoparticles at the JP surface, so that the translating Janus particle effectively becomes an externally controlled, mobile floating electrode capable of cargo transport and on-site DEP separation.

בברכה,

שרון אמיר

מרכז הסמינרים