**Motivation**

- Disease diagnosis, gene analysis, drug screening, tissue engineering – all these important biomedical applications require separation, manipulation, concentration and immobilization of specific bioparticles and cells. For successful application, these micro- and nano-sized particles need to be isolated from their original mixture (e.g., saliva, blood and other body fluids).
- Most of the traditional techniques (e.g., filtration, centrifugation, electromagnetic separation) for concentration and immobilization of bioparticles are time-consuming.
- Dielectrophoresis (DEP), one of the electro-kinetic methods, can be effectively used to separate and isolate particles based on their size, structural properties and behavior under induced electrical field.

**Method**

A neutral, but dielectric particle suspended in a medium becomes electrically polarized when subjected to a non-uniform electric field. This is due to partial charge separation which leads to an induced dipole within the particle. Based on the electric field and the medium, the particle experiences attraction or repulsion motion towards a specific pole of the electric field. For a homogeneous solid spherical particle of radius $r$, the DEP force is described by:

$$F_{\text{DEP}} = 2\pi r^3 \varepsilon_0 \varepsilon_m \text{Re}[f_{CM}] \nabla E^2$$

- $\varepsilon_m$ = permittivity of the surrounding medium
- $\nabla E^2$ = electric field gradient
- $f_{CM}$ = Clausius-Mossotti (CM) factor

A microfluidic device has been designed and fabricated with arrays of triangular, square and circular traps using photolithography and metal deposition techniques.

**Results**

The FE simulation results illustrate that –

- The weakest electric field region exists near the centroid region for the triangular, square and circular trap
- In case of n-DEP, generated DEP force along the electrode would push the particle from the edges to the weakest electric field region
- The downward DEP force (z-axis) plays an important role in particle trapping

**Discussion and Future Work**

The developed nDEP based-microfluidic device is successfully used to immobilize micro-particles. The finite element simulation results indicate variation on generated DEP-force inside and around the traps with changes in geometry of the traps. Initial experimental data reveals that the behavior of trapped particles is different for different shapes of the traps. Further analysis of the behavior of trapped particles from experimental data will provide more insights of the trapping force dynamics for each of the three different shapes. This results can be used to optimize the geometry of the trap for higher trap strength and improved trapping efficiency.

**References**