

MONDAY

COLLOQUIUM

How Can Electric Field Affect Cell Adhesion on a Microvascular Wall?

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6 Oct 2025 (Monday) | 16:00 Hrs (Tea / Coffee 15:45 Hrs) | Venue: TIFRH Auditorium

The adhesive interactions between cells are vital in regulating various biophysical processes that influence health and disease in living organisms. While much attention has been given to the rolling of cells on functionalised substrates that replicate biophysical pathways, the effects of an external stimulus, particularly an electric field, have been less explored. In this presentation, we examine the combined effects of fluid shear in low Reynolds number flows and electric fields on the rolling dynamics of adhesive cells in biofunctionalised micro-confinements.

Our experimental findings on bioengineered microcapillaries show that even weak electric fields, within physiologically relevant ranges, can significantly alter cell adhesion dynamics. We quantify these electric field-induced changes using two main parameters: the voltage-dependent rolling velocity and adhesion frequency. The experiments highlight the role of collagen functionalisation in influencing cell adhesion dynamics within microchannels. Moreover, the presence of an axial electric field significantly increases the rate of bond breakage, resulting in a reduction of cell-substrate adhesion, as indicated by a decrease in the frequency of cell adhesion.

Additionally, we offer a simple theoretical explanation for the kinetics of cellular bonding in the presence of an electric field, which closely matches our experimental data. These insights are crucial for understanding how electric fields can be used to locally control cell adhesion, with potential implications for a wide range of medical conditions, from wound healing to cancer metastasis.

Our results show that even weak electric fields, within physiologically relevant strengths, can notably affect cell adhesion dynamics. We assess the changes in these dynamics through two key measures: alterations in rolling velocity due to voltage and shifts in adhesion frequency.