There is burgeoning recent interest in designing mucoadhesive formulations which are useful for the prevention and treatment of ulcerative, inflammatory, and/or erosive disorders of mucous membranes and/or the delivery of pharmaceutically active compounds to mucosal surfaces for topical treatment or transfer to the systemic circulation. Often mucoadhesion is achieved by polymers containing numerous hydrophilic groups that adhere strongly to mucosal surfaces under physiological conditions. These polymers can extend the residence time of actives delivered through various mucosal administration routes (e.g. oral, nasal, vaginal). We propose a novel class of soft solids, “microgels”, which are sub-micron-sized soft hydrogel particles. Their tuneable charge distribution gives them a fuzzy surface to interact non-covalently with mucosa. Beyond electrostatics, the adhesive mechanism involving their ability to act as glue via hydrogen bonding with mucosal layers coupled with their large porous internal structure to entrap actives and stimuli-responsive properties for release should make these ideal mucoadhesive delivery vehicles. Although the adhesion of synthetic microgels to cells has long been a focus of biophysical research, their mucoadhesive performance has remained largely unexplored. These cationic microgels may open up new exciting opportunities due to their deformability, tunability, ability to be trapped in various configurations, from highly spread to compressed and close packed, when interacting with various surfaces. In addition, functionalizing the surface of such microgels with tethers of linear/ block copolymers containing charged moieties could further the anchoring within the mucosa. In this PhD project, we propose to design novel microgels with targeted architecture and create a new understanding of their mucoadhesive properties in response to various surfaces of biological roughness, deformability and wettability using advanced experimental as well as modelling techniques.