Progress in microfabrication technologies makes it possible to design and fabricate autonomous self-assembling microparticles called lablets (under 100 μm in size), which can implement programmable microscale electronic chemistry, forming a bridge between electronic and chemical computing. Due to limited energy storage capacity of the lablets and high material density, their movement in aqueous environment over larger distances and attachment to a predefined substrate (docking station) remains a challenge. The aim is precise positioning of the lablet above the docking station in aqueous environment, followed by controlled attachment of the lablet on predefined part of the docking station. The position of the lablet with respect to the docking station has to be within the range of 10’s of micrometers.

The lablets are mainly composed of silicon (density 2.57 g.cm⁻³), hence they are denser than water and thus remote manipulation with the lablets above the docking station in aqueous environment is not possible due to their sedimentation. 150 - 200 μm small surfactant stabilized oil droplet (kerosene, density 0.80 g.cm⁻³) were attached to the lablets in order to decrease their overall density. The oil microdroplets with attached lablets were observed to be floating on the water-air interface. Since one side of the lablets surface is formed from silicon (Si) while the other one contains also gold electrodes (for communication with the dock station), it is required to attach the lablets to the oil droplets in such a way that the gold electrodes will be immersed only in the water phase and thus be able to communicate with the dock station. The immersion of the lablets in the oil phase can be changed by hydrophilic/hydrophobic modification of the lablets surface.

In order to make the remote manipulation possible, magnetic (iron-oxide) nanoparticles with a hydrophobic modification (oleic acid stabilized) were added to the oil (kerosene) phase to create a ferrofluid. The ferrofluid will consequently move in a magnetic field and carry the lablet with it. The magnetic field is created by four electromagnets (the distance between two opposite electromagnets will be 25 mm), allowing us to precisely manipulate with the lablets in the X,Y (planar) direction. Depending on the voltage applied and the concentration of magnetic particles in the ferrofluid, tablets can be moved with a velocity of 10'-100’s μm/s. The attachment of the lablet to the docking station will be achieved by placing another electromagnet below the docking station, hence we will be able to move/elongate the ferrofluid microdroplets in the Z (vertical) direction that will consequently lead to the connection of the lablet with the docking station.

The lablets can also act as carriers of active substances, i.e. liposomes with encapsulated substrate attached on the lablets surface. The release of the encapsulated content can be triggered by i) radiofrequency heating which causes a reversible phase transition of the lipid bilayer; or by ii) electroporation of the lipid bilayer. By controlled release of the substrate, we are able to trigger an enzymatic reaction on-demand. This principle makes it possible to deliver unstable or reactive active ingredients that cannot be formulated into traditional dosage forms.