Electrochemically supported devices are used constantly by about 80% of adult population of industrial/developing world. This refers primarily to power sources: lithium batteries provide energy to watches; accumulators feed our mobile phones, photo-cameras, laptops and other gadgets. But now a new ‘intervention’ of electro-chemistry into daily life may take place, and we are not talking about fuel cells.

Electrically driven variable focus optics based on the principles of electrowetting is expected to revolutionize portable video equipment. But when such devices are designed on the basis of the principles of macroscopic physics, they ordinarily require voltages of the order of 25-300 V to cause a considerable variation of the focus distance (through the variation of the shape of the lens) or filtering (through the change of the colour of the pixel). Energy demanding, as the latter scales as \( V^2 \), this also requires high voltage transformers, which makes the device more complicated for portable applications.

However, a recent discovery made by a team of theorists (Kornyshev and Monroe at Imperial, Daikhin and Urbakh at TAU) and experimentalists (Alice Sleightholme and Anthony Kucernak at Imperial) may solve the problem. Using the ideas about the double layer at the interface of two immiscible electrolytic solutions — ITIES — this team has shown how to modify these devices so that they will be able to change the shape of a lens over only 0.2-0.4 V. This makes a decisive difference for application of variable optics in portables and is likely to change this technology for video equipment. When applied to stationary devices, such as desktop-displays or projectors, it will help to save energy. Even easier it can be used in electronic paper devices.

This lecture will introduce the principles that make ultra-low voltage electrowetting possible and overview the experimental results on which the team is going to base future prototype devices. The last part of the talk will focus on the original pulsing technique developed for speeding-up the electrowetting response and understanding its dynamics. We will show that using the ITIES electrowetting configuration offers unique novel tools for the study of contact angle pinning and hysteresis on rough surfaces, the key issues in the science of wetting. Thus, apart from a world of practical applications this system provides new options for fundamental research.