AC electronic surface compressibility in 3D HgTe topological insulator

A. Inhofer[1], B.A. Assaf[2], Q. Wilmart[1], G. Fève[1], J.M. Berroir[1], E. Bocquillon[3], K. Bendias[3], H. Buhmann[3], L.W. Molenkamp[3], and B. Plaçais[1]

[1]*Laboratoire Pierre Aigrain, Ecole normale supérieure, PSL Research University, CNRS, Université Pierre et Marie Curie, Sorbonne Universités, Université Paris Diderot, Sorbonne Paris-Cité, 24 rue Lhomond, 75231 Paris Cedex 05, France*
[2]*Département de Physique, Ecole normale supérieure, CNRS, PSL Research University, 24 rue Lhomond, 75005 Paris, France*
[3]*Physikalisches Institut (EP3), Universität Würzburg, Am Hubland, 97074 Würzburg, Germany*

The advent of Dirac-matter, most notably topological insulators (TIs), is expected to revolutionize the designs and concepts of device technology. However, most novel device designs are based on electron transport properties of gate-tuneable surface state densities. Understanding the field-effect response in metal-oxide-TI (MOTI) systems is therefore an essential task. We investigate the field-effect response of MOTI-capacitors in the high-frequency range up to 40GHz. By virtue of a gate electrode, we are able to control the surface chemical potential over a bipolar energy range. Our measurements provide the energy dependence of the electronic surface compressibility and conductivity. We will present a comparative study of these electronic properties between uncapped samples, exhibiting lithography-induced doping, and a capped (almost dopant-free) samples. This comparison gives new insight into the electrostatics of TI devices, in particular with respect to screening due to surface and bulk states which is supported by compressibility modelling. Furthermore, I will discuss specific features of topological matter ranging from bulk-surface scattering suppression to the topological response of surface states to strong external electric fields.

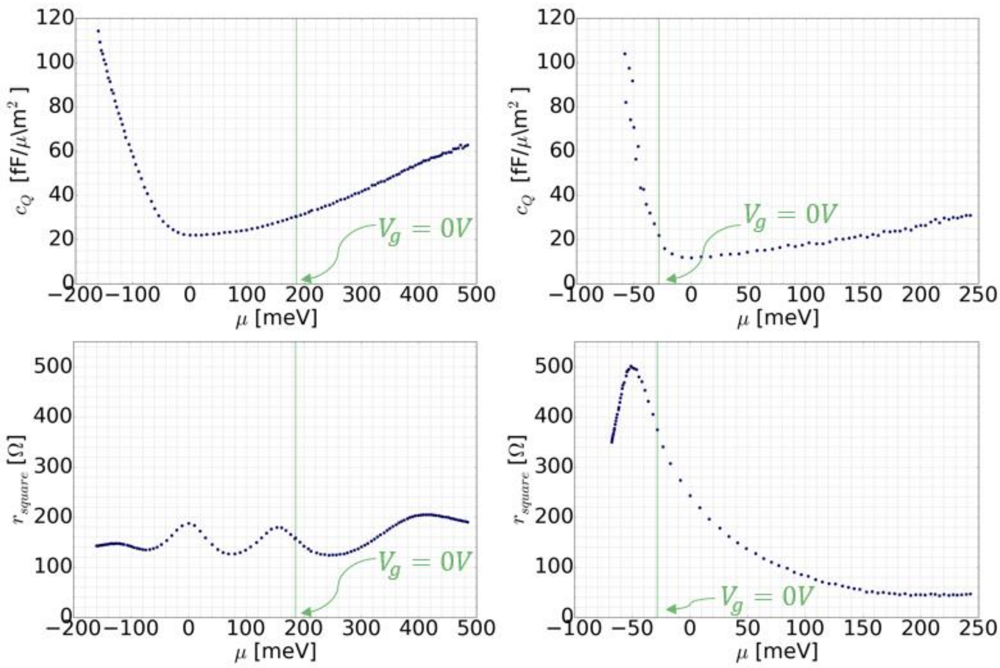

Fig. 1. Electronic surface compressibility and sample resistivity vs surface chemical potential in left) uncapped (i.e. doped) and right) capped (i.e. undoped) samples. The origin of surface chemical potential is set to the position of the capacitance minimum.