Surface and interface mobility of charge carriers play a crucial role for the durability of metal/organic coating interfaces. Knowledge about to which extent they are affected by the interface chemistry would be valuable information to be used in the design of polymer formulations and surface pretreatments of metals. Despite this importance, studies on the surface and interface mobility of charge carriers are limited. One reason for that is the scarcity of analytical techniques capable of probing buried interfaces. This thesis aims at improving the current use of one of these techniques, i.e. Scanning Kelvin Probe (SKP), by introducing an experimental approach devised for measuring the mobility of the charge carriers on oxide surfaces. To investigate the effect of the oxide chemistry on the mobility, differently pretreated aluminum oxide surfaces were characterized by the X-ray Photoelectron Spectroscopy (XPS) and Visual Spectroscopic Ellipsometry (Vis-SE) techniques prior to the devised mobility experiments.

The results revealed the linear correlation of the hydroxyl fraction of Al oxides with the potential values obtained by the SKP technique. In the mobility experiments, the effect of the oxide chemistry was investigated as a function of the chemical differences induced by the pretreatments and the humid atmospheric exposure. It was shown that the mobility of the adsorbed counterions is related to the type of the dominating surface fixed charges. Though the nature of the fixed charge groups is mainly determined by the pH of the pretreatment solutions, the ambient conditions were also found to affect the surface chemistry by the acidification effect of CO₂. In the same context, (dis)charging mechanisms for different materials were investigated by means of an in situ SKP apparatus implemented to the beamline of a synchrotron radiation facility. Comparable effects of the pretreatment-induced fixed charges were also observed on the (dis)charging mechanisms of the X-ray-exposed silica surfaces. Furthermore, the applicability of the approach for studying interfacial mobility was tested by the deposition of lipid multilayers and ionic liquid on silica and sapphire substrates, respectively. The different potential responses with respect to the behavior of bare substrates were discussed.