Abstract

The dissertation mainly deals with the protection of corrosion by novel combination of production processes which have a high sustainability in the economy. Topics like effects of the plasma modification on the adsorption kinetics of adhesion promoters, investigations on the adhesion promoters as corrosion inhibitors, and the influence of the surface chemistry on the stability of adsorbed adhesion promoters are brought into focus. It is shown, that plasma modification can influence the electronic and geometric parameters of the passive layers and thereby prevent corrosion, as well as the adsorption process of the adhesion promoter. The quartz crystal microweighing (QCM) is applied for the first time as a method for the determination of adsorption kinetics of organophosphonic acids on aluminum. Investigations of the adhesion promoters adsorbed on passive layers lead to the conclusion, that a further adsorption of water can be reduced but the diffusion itself to the passive layer cannot be hindered. The variation of surfaces and alloy composition has shown that adhesion promoters have to be adapted to the parameters of subject system to reach certain stability. The stability of the resulting bonding is mainly based on three competing influences, namely interfacial bonding types, adsorption free energies in competition with water and the involved adsorption geometries. By the introduction of new single crystalline model systems a gap between the modern theory and experimental data can be bridged. For water-rich conditions the formation of the adsorbing water is predicted by density functional theory (DFT) and proven by temperature programmed desorption (TPD) spectroscopy. In one can say that phosphonic acids are the most promising candidates as adhesion promoters for aluminum and alloys that form up oxide covered aluminum surfaces. Furthermore, the plasma modification is an efficient process for cleaning and changing the surface parameters in electronic and geometric way, which facilitates the possibility to tailor the surface chemistry. For the future, only a combination of basics research on the one hand, and direct cooperation with industry on the other hand, can be the key for fundamental comprehension and adequate progress.