MONITORING AND INVESTIGATIONS OF ORGANIC ELECTROCHEMICAL REACTIONS WITH IN SITU INFRARED SPECTROSCOPIC TECHNIQUES

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Each electrochemical technique provides a different kind of information about the mechanism of an electrode process. The most important techniques are cyclovoltammerty, polarography, coulometry and preparative electrolysis. These methods give a lot of information about the kinetic and the mechanism of electrode reactions. But the reaction products or any intermediates can not be detected directly. Only the combinations of electrochemical techniques with spectroscopic methods allow detailed information about the products and intermediates of the reactions themselves. The most powerful tools designed to obtain spectroscopic information on electrochemical reactions are Electron Spin Resonance (ESR) and Molecular Spectroscopy (Infrared and Raman spectroscopy). This paper gives an overview about the application of in situ infrared spectroscopic methods and their combination with different electrochemical techniques.

For in situ infrared spectroscopic investigations of electrode reactions two different techniques can be applied. These techniques are the **A**ttenuated **T**otal **R**eflection (ATR) spectroscopy and the external **I**nfra**R**ed **R**eflection **A**bsorption **S**pectroscopy (IRRAS).

The applicability of attenuated total reflection spectroscopy for the investigation of electroorganic reactions is restricted either to infrared transparent electrodes (Si, Ge) or to very thin metal films evaporated on any infrared transparent material. The possibility of using each electrode material without any limitation of thickness is the big advantage of external reflection absorption spectroscopy. The strong absorbance of the infrared radiation by the electrolyte solution requires a short distance between the electrode surface and the infrared transparent window (some µm).

The in situ monitoring of electroorganic reactions can be done by a combination of flow through cells in series both for synthesis and infrared spectroscopy. For high flow through rates as in industrial scale plants the ATR technique is the most suitable method because such flow through cells are not limited with regard to the flux.

This paper presents new results of infrared spectroscopic investigations of electroorganic reactions of some aliphatic, aromatic and heteroaromatic compounds and compares the different methods relating their advantages as powerful in situ spectroelectrochemical technique.