EFFECTS OF SURFACE MODIFICATION ON CHARGE-CARRIER DYNAMICS AT SEMICONDUCTOR INTERFACES

Thesis by

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Abstract

Understanding the basic concepts of semiconductor junctions is an important step towards the development of efficient solar energy conversion devices. The work described in this dissertation includes both the investigation of semiconductor/liquid junctions and the modification of semiconductor surfaces for achieving chemical control over physical properties.

The interfacial charge-carrier dynamics of *n*-GaAs/CH_3CN junctions has been investigated. Differential capacitance barrier height measurements and steady-state current density–potential (*J*–*E*) measurements were used to evaluate the degree of partial Fermi-level pinning. The presence of irreversible chemical and/or electrochemical changes on *n*-GaAs electrodes immersed in CH_3CN-$CoCp_2^{+/0}$ solutions was examined using x-ray photoelectron spectroscopy (XPS) and cyclic voltammetric studies that were designed to probe surface reactions.

Chemical modifications of semiconductor surfaces can provide a reliable mean to control physical properties of semiconductor interfaces. The growth of robust polymer films that are covalently attached to Si surfaces via a Si-C linkage was demonstrated. Uniform polymer overlayers of different thicknessess were formed using a general method combining chlorination/Grignard reaction with ring-opening metathesis polymerization (ROMP). The surfaces of these modified Si were characterized by x-ray photoelectron spectroscopy (XPS), scanning electron microscopy (SEM), ellipsometry, and/or profilometry. The charge-carrier dynamics at these modified Si/air interfaces was investigated using transient photoconductivity decay method. Time-dependent photoconductivity measurements further confirmed the ability for polymer-terminated Si to maintain low surface recombination velocities once exposed to the air.

Table of Contents

Chapter 4 Transient Photoconductivity Decay Measurements of Polymer-Terminated Silicon Surfaces 113

List of Figures

Chapter 1

Chapter 2

Chapter 3

Chapter 4

List of Tables