## Preface

Polymer-metal complexes are increasingly important and have gained much interest due to their extraordinary properties such as binding of small molecules, electron transfer processes, therapeutic effect compared to pure organic polymers, which arise from the synergism between the properties of the components.

One of the significant properties of polymer-cobalt complexes is the specific and reversible oxygen-binding ability. Therefore, cobalt complexes as oxygen carriers play an important role in helping to elucidate the biochemical activity of hemoglobin. Furthermore, the cobalt complexes indicate the potential applications for air separation membrane and oxygen electrode in metal/air batteries and fuel cells.

It was found that cobaltporphyrins fixed in polymer membranes could facilitate oxygen transport relative to nitrogen, therefore, both the permeability and selectivity can be remarkably improved. However, cobaltporphyrins often irreversibly oxidize and their lifetimes are limited. Furthermore, physicochemical properties and chemical reactivities of metal complexes are strongly affected by interactions with the matric polymers. From this viewpoint, various matric polymers including fluorine-containing copolymers were carefully designed and synthesized. The effect of matric polymers on the oxygen-binding affinity, facilitated transport efficiency, permeability and selectivity, and the operational lifetime of cobaltporphyrin membranes were discussed.

In addition, the design of oxygen electrodes with improved performance in metal/air batteries and fuel cells is one of the important goals in electrochemical oxygen technologies. Because the supply of air (oxygen) is virtually inexhaustible, the oxygen electrode can, in principle, function indefinitely and its capacity can be considered infinite. However, the reduction of oxygen is so rapid because of the extensive studies of catalysts that even with the recent gas-diffusion electrode the discharging current is often limited by the transport of oxygen. In the second part of this thesis, the author aimed at modifying oxygen electrodes with cobalt complexes, and expected to accumulate oxygen from aqueous electrolyte solutions, therefore, improved the performance of oxygen electrodes.

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## Contents