# 論文 / 著書情報
# Article / Book Information

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# 博士論文要約

**題名:** Novel plasma-induced graft polymerization for fabricating functional membrane materials from porous substrates（多孔質基材を用いた機能膜開発のための新規プラズマグラフト重合法）


要約：

Plasma-induced graft polymerization (PIGP) is one of the most efficient grafting methods explored for fabricating functional materials from porous substrates, due to its superior efficiency in forming grafted layers inside the nano-sized pores while maintaining the bulk property of the substrate. It has been successfully used to prepare materials with superior functional properties, such as drastic response gating membranes and high selectivity pervaporation membranes. At the same time, some prevailing challenges act as barriers for the wide-scale application of PIGP. One of the major problems is the limited number of monomers that can be employed in this technique. This problem is basically associated with the lack of understanding about the grafting mechanism inside the pores. Being aware of this important issue, the present study is devoted to investigate the mechanism of grafting inside pores, with the goal of exploring larger application prospects for PIGP.

Based on a sulfonic monomer 2-acrylamide-2-methylpropane sulfonic acid and a porous polyethylene substrate, a novel PIGP approach applicable to monomers having low PIGP reactivity is proposed and subsequently investigated on its mechanism as well as the polymer growth features with sufficient consideration given to the porous structure of the substrate. In this approach, infiltration agent is employed to help monomer solution to infiltrate into the pores, which has been confirmed essential for grafting inside the pores of porous substrate. Another key feature of the approach is that it prefers a lower grafting temperature range than the conventional PIGP does, which has been found to be associated with the acidic condition. The acidic condition decreases the working temperature of the peroxide initiator produced by plasma-irradiation and subsequent air exposure. The proposed PIGP approach enables direct grafting of different monomers including several sulfonic monomers and quaternary ammonium monomers, and the lower grafting temperature allows the utilization of thermally labile monomers.

The further study on the structure of grafted polymers inside pores reveals that the molecular weight and density of grafted polymer chains can be adjusted by controlling the grafting temperature, which affects the performance of the membrane.

In short, the present study expands the available range of monomers in PIGP, thereby diversifying the achievable functional materials by PIGP. Furthermore, the findings on the effect of grafted polymer structure on the membrane performance provide a valuable guideline for graft-material design and their performance optimization. Hence, the achievements in this study are expected to contribute on promoting the emergence of novel high-functional materials.