論 文 の 内 容 の 要 旨

論文題目　**Design and Synthesis of Functionalized Nanostructured Materials for Selective Ion Recognition**

（選択的イオン認識のための機能性ナノ構造材料の設計と構築）

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Lithium has been attracting considerable attention due to its extensive applications in various fields, such as glass and ceramics processing, lubricants and pharmaceuticals, especially in modern energy technology. Currently, lithium ion batteries (LIBs) are widely being used for electronic products, dominating the rechargeable battery market of cellular phones, laptop computers, cameras, cordless power tools and electric-powered vehicles. Today LIBs represent about 37% of the rechargeable battery world market and their use keeps steadily increasing. All these have make lithium become a very important commodity for modern life. As demand for lithium has begun to grow dramatically after the turn of the century, mining lithium in a more efficient and economically-feasible way is of great interest. Design of new functionalized nanostructured materials that exhibit selective ion recognition towards lithium will contribute to the development of new techniques for lithium resources. The objective of this thesis is to develop new functionalized nanostructured materials for efficient selective lithium ion recognition. Two kinds of nanostructured materials targeting selective lithium ion recognition have been designed and synthesized in this thesis.

In ***Chapter 1***, the general introduction about the background and principle of this study are described.

In ***Chapter 2***, the design of new liquid-crystalline (LC) lithium receptors is reported. The tunable nanostructure and functionality of LC assembly enable it to become an outstanding candidate for the design of nanostructured ion receptors or transporters. However, lithium ion-selective LC materials have not yet been reported to the best of our knowledge. New lithium selective receptors with mesogenic moieties that exhibit stable LC phases were synthesized. The effects of molecular structure and lithium salt addition on their phase behaviors were investigated.

In ***Chapter 3***, the selective lithium ion recognition in the self-assembly of columnar liquid crystals based on lithium receptors has been investigated. In the previous chapter, self-assembled columnar liquid crystals based on lithium receptors were obtained via the coordination interaction between the lithium selective moiety and lithium ion. The aim of this chapter is to evaluate and study about the selective lithium ion recognition in this new nanostructured LC materials. The experimental results suggest that the high selectivity of the LC receptor for Li^+ results from both the preferred coordination number and the favoured geometry.

In ***Chapter 4***, the lithium-selective LC receptors modified with polymerizable end groups have been designed and synthesized. The LC columnar structure formed by polymerizable lithium selective receptors was fixed photopolymerization. Robust free-standing polymer films consisting of LC nanostructure have been obtained.

In ***Chapter 5***, lithium ion-imprinted polymer materials have been prepared. The as-prepared polymers were characterized by NMR, XRD and TGA measurements. After removing the imprinted lithiunm ion from the polymeric matrix, the resulting materials are expected to be used as extractants for selective lithium extraction in both liquid-liquid/solid extractions.

In ***Chapter 6***, the conclusion and perspectives of this thesis are presented. Two kinds of nanostructured materials targeting selective lithium ion recognition have been designed and synthesized in this thesis. The functionalized nanostructured materials described in this thesis can be applied to the fabrication of various ion-recognizing materials, and opens new pathways for the development of new techniques for efficient lithium-selective extraction.