外　国　語　要　旨

学位論文題目「Development of Novel Foldamers Based on Conformational Property of Aromatic Tertiary Amide」

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Foldamer is a molecule which constructs highly ordered structure by weak noncovalent intra- or intermolecular interactions. For instance, DNAs that adopt helical conformation and proteins that take α-helix and β-sheet are natural foldamers. These biopolymers recognize other biomolecules or themselves specifically and carry out the essential and crucial functions. These functions and their structures are closely related. To investigate the relationship and develop artificial molecules mimic or superior to natural biopolymers, various kinds of foldamers have been developed. In particular, helical structure has molecular chirality in itself, that is, right-handed and left-handed helices. Therefore helical foldamer are attractive in view of control of helical handedness and chiral recognition of helical cavity.

Our research group has elucidated the conformational property of aromatic amide. Aromatic secondary amide such as benzanilide exists in trans form, whereas their *N*-alkylated tertiary amide exists in cis form, both in the crystal and in various solvents (Figure 1). Furthermore, *N*-alkylated poly(*p*-benzamide)s took a dynamic helical structure by repeating the folding cis structure of *N*-methylbenzanilide moiety. In this thesis, novel helical and cyclic foldamers were developed based on the unique property of the aromatic tertiary amide.

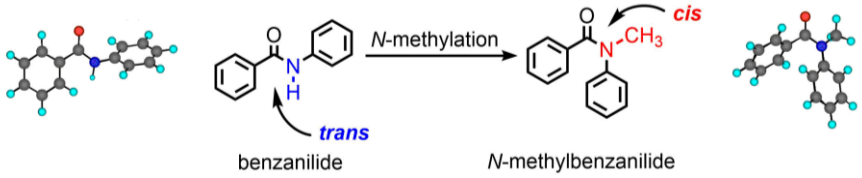

Figure 1. Conformational property of aromatic amide.

At first, two kinds of helical oligomers which would have larger cavities, compared to those of *N*-alkylated poly(*p*-benzamide)s, were designed and synthesized (Chapter 2). The cavity of *N*-alkylated poly(*p*-benzamide)s was narrow, which was difficult to apply to molecular recognition. Then, in this study, linkers such as secondary amide bond (**1** - **4**) and triple bond (**5** - **11**) were introduced to *N*-alkylated amide oligomer to extend the cavity (Figure 2a). As for the amide oligomers bearing secondary amide linker, the helical structures with intramolecular hydrogen bonds between secondary amide bonds were suggested (Figure 2b). Due to the intramolecular hydrogen bonds, induced chirality of helical oligomers by addition of chiral molecules was not observed. On the other hand, the amide oligomers bearing triple bonds vary their helical structures depending on solvent polarity. As well as the amide oligomers linked by secondary amide bonds, induced chirality was not detected by addition of chiral molecules, but NMR analysis showed their interactions with anions and cations.

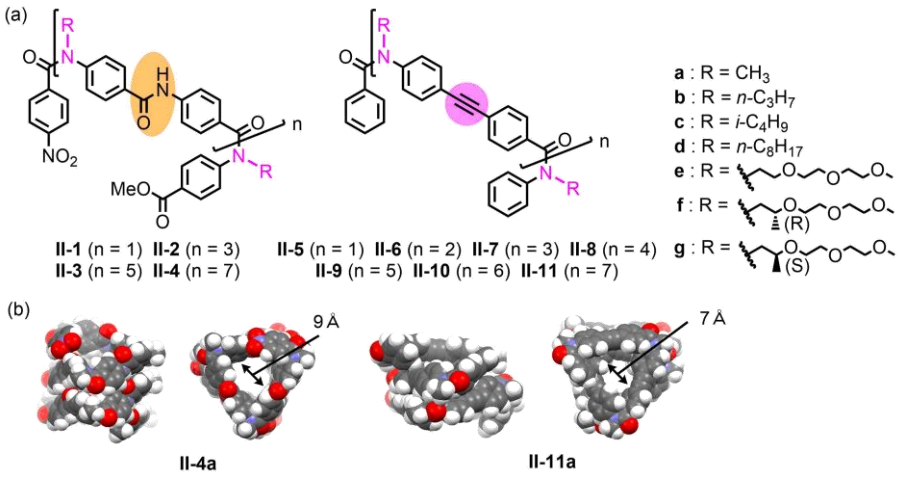

Figure 2. (a) Chemical structures of the helical oligoamides and (b) their optimized structures.

The cis preference of aromatic tertiary amide is applicable to develop cyclic quinoline oligoamides from helical oligoamides (Chapter 3). Only cyclic trimer and tetramer of quinoline oligoamides were reported so far and larger macrocycles were not denatured from secondary oligoamides. Then, tertiary amides were introduced to produce kink to helical conformations expecting to facilitate the formation of macrocycles (Figure 3a). Several lengths of oligoamides were synthesized and their cyclocondensations were examined. As a result, intramolecular cyclizations were preferred and novel pentamer, hexamer and heptamer were obtained. Their crystal structures showed these macrocycles contain helical parts and strive to maximize their helical content despite being constrained in a ring structure (Figure 3b).

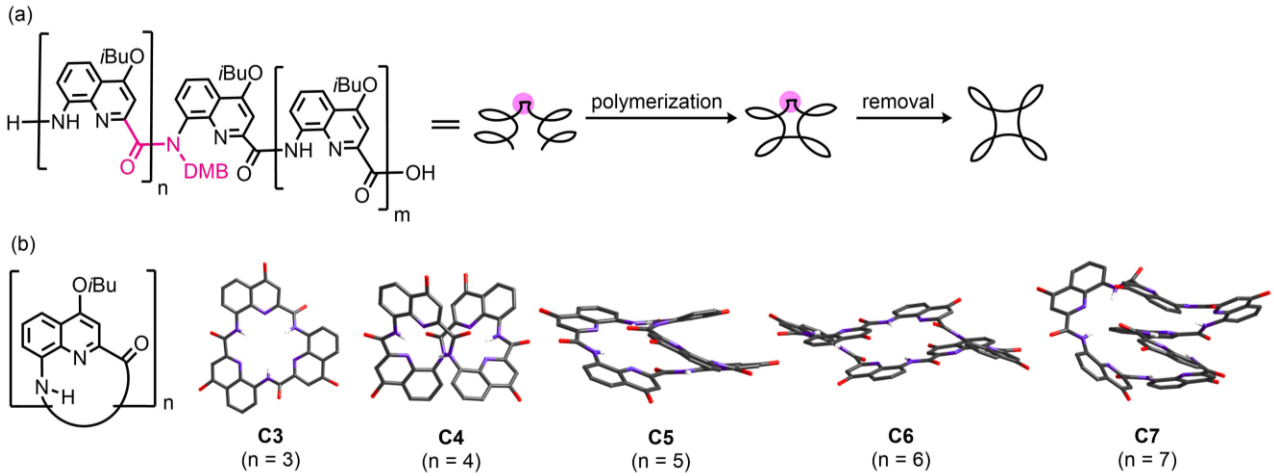

Figure 3. (a) Schematic concept of this study and (b) crystal structures of cyclic quinolone oligoamides.

In conclusion, novel helical and cyclic foldamers were developed and their conformations were investigated. These results show that the aromatic tertiary amide with cis conformation is useful motif as not only the skeleton of foldamer but also auxiliary for foldamer synthesis.