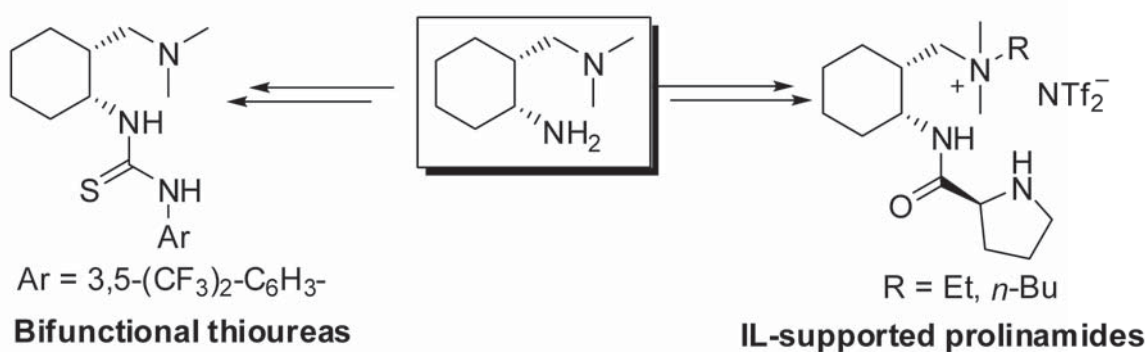


氏 名	王 万輝
博士の専攻分野の名称	博士（工学）
学位記号番号	博理工甲第 831 号
学位授与年月日	平成 23 年 3 月 23 日
学位授与の条件	学位規則第 4 条第 1 項該当
学位論文題目	Chiral organocatalysts for asymmetric Michael addition derived from 1,3-diamines (光学活性 1,3-ジアミンから誘導した有機触媒の不斉 Michael 付加反応への応用)
論文審査委員	委員長 教 授 廣瀬 卓司 委 員 教 授 斎藤 雅一 委 員 教 授 三浦 勝清 委 員 准教授 杉原 儀昭

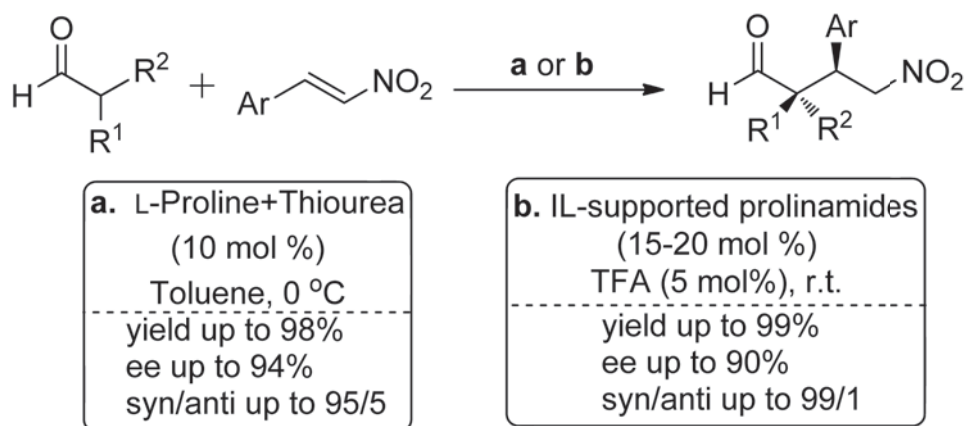
論文の内容の要旨

A chiral 1,3-diamine derived from *cis*-(1*S*,2*R*)-2-benzamidocyclohexanecarboxylic acid has been utilized for development of new organocatalysts for asymmetric Michael addition. Chiral bifunctional amino thioureas and ammonium ionic-liquid-supported (IL-supported) prolinamides have been designed and synthesized from the 1,3-diamine. These amino thioureas and the IL-supported prolinamides have been applied in catalytic asymmetric Michael addition of aldehydes to nitroolefins with high activity and stereoselectivity.

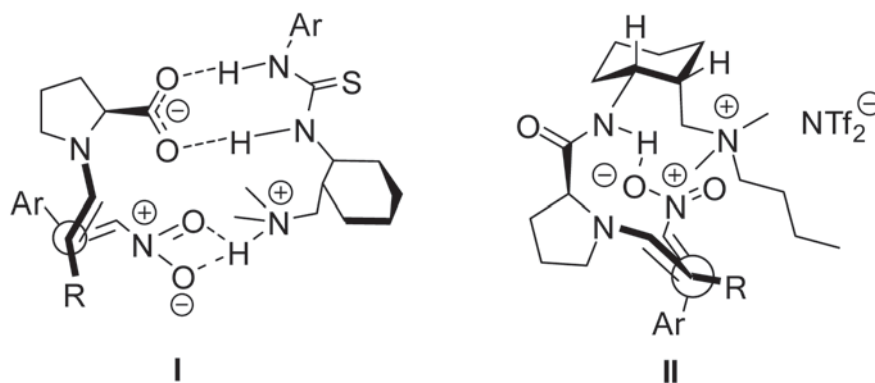


A series of novel chiral 1,3-diamines has been synthesized from commercially available *cis*-(1*S*,2*R*)-2-benzamidocyclohexanecarboxylic acid, *trans*-(1*S*,2*S*)-2-benzamidocyclohexanecarboxylic acid, and (1*S*,2*S*,3*R*,4*R*)-3-benzamidobicyclo[2.2.1]heptane-2-carboxylic acid. The 1,3-diamines were reacted with various isothiocyanates to give diverse of chiral bifunctional amino thioureas. The amino thioureas have been applied as co-catalysts of proline in asymmetric Michael addition of aldehydes to nitroolefins in less-polar solvents. The self-assembled L-proline amino thioureas have been demonstrated to be efficient organocatalysts for the asymmetric Michael addition, requiring a catalyst loading of only 10 mol% and small excess of aldehydes (3 equiv). Significantly improved reaction rate (up to 98% yield for 18h) and enantioselectivity (up to 94% ee) have been achieved.

On the other hand, two chiral ammonium IL-supported prolinamides have been newly designed and synthesized from a 1,3-diamine derived from *cis*-(1*S*,2*R*)-2-benzamidocyclohexanecarboxylic acid. The prolinamides have been proved to be efficient organocatalysts for asymmetric Michael addition of aldehydes to nitroolefins with excellent yields (up to 99%), high enantioselectivities (up to 90% ee) and modest to high diastereoselectivities (*syn/anti* ratio up to 99/1). The IL-supported organocatalysts can be reused twice with almost constant enantioselectivity despite a little loss of catalytic activity.



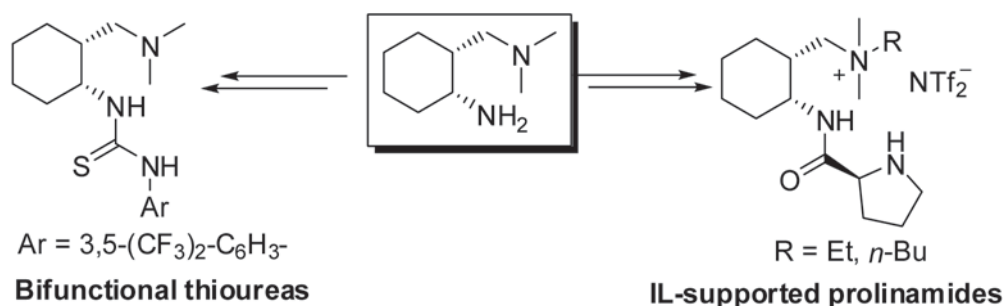
Based on our studies of NMR experiments and theoretical calculations, the mechanisms of two catalytic systems were proposed, respectively.



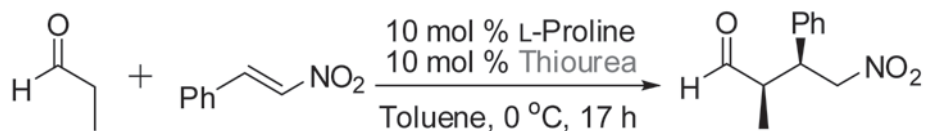
論文の審査結果の要旨

本学位論文審査委員会は、当該論文の発表会を1月21日（金）に公開で開催し、詳細な質疑と論文内容の審査を行った。以下に、審査結果を要約する。

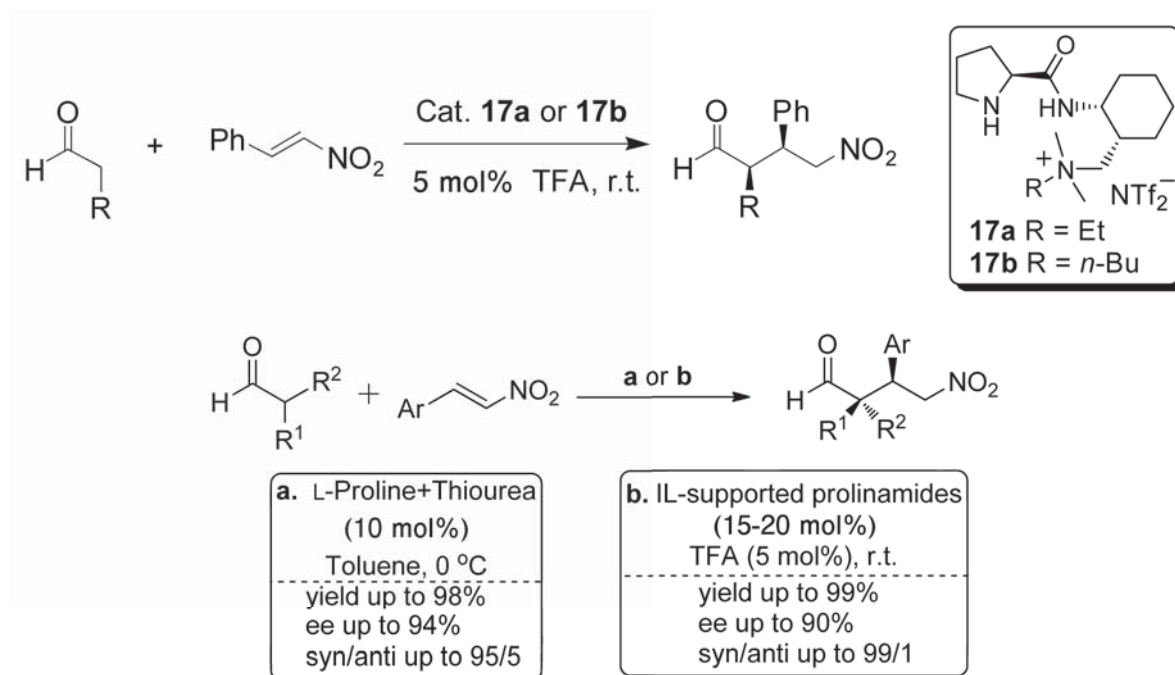
This work consists two parts concerning with the synthesis of two kinds of organic catalysts and their application to catalytic asymmetric Michael addition. That is, a chiral 1,3-diamine derived from *cis*-(1*S*,2*R*)-2-benzamidocyclohexanecarboxylic acid has been utilized for development of new organocatalysts for asymmetric Michael addition. Chiral bifunctional amino thioureas and ammonium ionic-liquid-supported (IL-supported) prolinamides have been designed and synthesized from the 1,3-diamine. These amino thioureas and the IL-supported prolinamides have been applied in catalytic asymmetric Michael addition of aldehydes to nitroolefins with high activity and stereoselectivity.



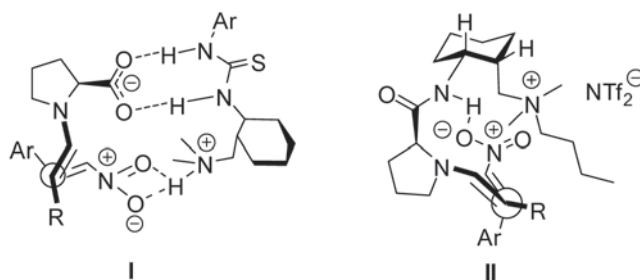
A series of novel chiral 1,3-diamines has been synthesized from commercially available *cis*-(1*S*,2*R*)-2-benzamidocyclohexanecarboxylic acid, *trans*-(1*S*,2*S*)-2-benzamidocyclohexanecarboxylic acid, and (1*S*,2*S*,3*R*,4*R*)-3-benzamidobicyclo[2.2.1]heptane-2-carboxylic acid. The 1,3-diamines were reacted with various isothiocyanates to give diverse of chiral bifunctional amino thioureas. The amino thioureas have been applied as co-catalysts of proline in asymmetric Michael addition of aldehydes to nitroolefins in less-polar solvents. The self-assembled L-proline amino thioureas have been demonstrated to be efficient organocatalysts for the asymmetric Michael addition, requiring a catalyst loading of only 5-10 mol% and small excess of aldehydes (3 equiv). Significantly improved reaction rate (up to 98% yield for 18h) and enantioselectivity (up to 94% ee) have been achieved.



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Based on our studies of NMR experiments and theoretical calculations, the mechanisms of two catalytic systems were proposed, respectively.



以上のように、本論文は光学活性な 1,3-ジアミンから誘導される有機触媒の合成と、それらの触媒的不斉マイケル反応への応用し、溶媒、添加剤等の検討の結果、良い収率と立体選択性を実現した。さらに、その反応機構ならびに遷移状態の解析を実験的及び計算化学的に行い、学術的、工学的に価値ある内容と判断された。よって本審査委員会は博士（工学）の学位に十分値するものとみとめ、「合格」との判定を行った。