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Dedicated to V. F. Mironov on His 60th Anniversary

Betti Base in the Synthesis of Chiral Bisphosphorylated Thioureas

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Abstract—Phosphorylation of a naphthol hydroxy group of thiophosphorylated thiourea obtained by reaction of diethyl thiophosphoryl isothiocyanate with 1-(α-aminobenzyl)-2-naphthol (Betti base) afforded a number of chiral bisphosphorylated thioureas. Molecular structure of the obtained compounds was studied by single crystal X-ray diffraction. The capacity of the studied compounds for dimerization due to the intermolecular N–H···S hydrogen bonding was revealed.

Keywords: thiophosphorylated thioureas, Betti base, *O*-phosphorylation, intra- and intermolecular interactions, packing polymorphism

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Substituted thioureas are an important class of organic compounds with useful properties. They are promising for utilization in medicine and agriculture, because they have a pronounced biological activity [1–5]. Moreover, being active proton donors, they can be involved into complexation reactions with anions and used for creation of various sensors [6, 7]. Chiral enantiopure thioureas are widely used in organocatalysis [8, 9]. More and more attention of researchers has recently been attracted to thiophosphorylated derivatives of substituted thioureas, since the introduction of thiophosphoryl groups into the urea molecule provides the appearance of additional coordination sites that can be used for design of new types of coordination compounds with useful properties [10, 11]. Such thioureas are very accessible, since their synthesis can easily be carried out by the reaction of thiophosphoryl isothiocyanates with primary and secondary amines. However, there are only a limited number of examples of the application of chiral amines in racemic or enantiopure form in this reaction, which could lead to the preparation of chiral thiophosphorylated thioureas. For the first time such compounds in racemic and enantiopure forms we have described in [12, 13]. We believe that the introduction of chiral elements into the molecules of thiophosphorylated thioureas opens new possibilities for their use, for example, in catalysis as ligands or organocatalysts, as well as for the creation of new bioactive molecules or magnetoactive complexes.

It should be noted that in recent years the Betti base [1-(α-aminobenzyl)-2-naphthol] has been increasingly used in asymmetric organic synthesis [14], including the synthesis of organophosphorus compounds [15–21]. Recently we obtained chiral thiophosphorylated thiourea **1** by reacting *O*,*O*-diethyl thiophosphoryl isothiocyanate with a racemic Betti base [12]. Unfortunately, this thiourea is unstable and easily undergoes intramolecular cyclization in the presence of bases (Scheme 1), which is due to the presence of a free naphthol hydroxy group capable of intramolecular nucleophilic attack at the C=S bond with the ring closure.

In order to prevent undesirable cyclization, on the one hand, and to increase the stability and preserve the multidentity of the potential ligand, on the other, it was necessary to protect the hydroxy group in such a way