

SHORT  
COMMUNICATIONS

## Microwave-Assisted Synthesis of Bithiazole Derivatives under Solvent-Free Conditions\*

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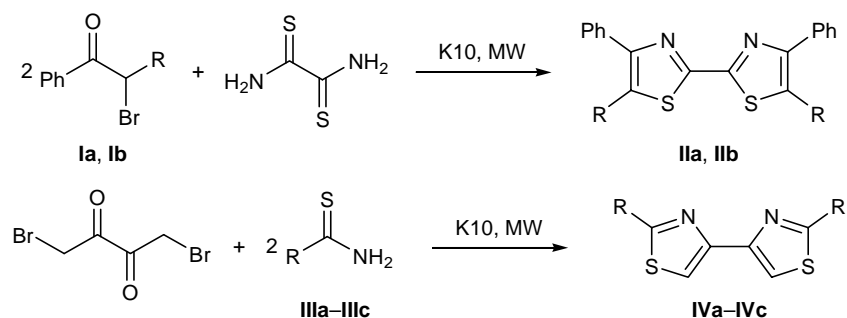
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Bithiazole derivatives play an important role in the synthesis of polymers possessing magnetic properties [1], manufacture of high-performance electroluminescent devices such as light-emitting diodes [2], and medicine. For example, aminoalkyl derivatives of 2,4'-bithiazole-4-carboxylic acid were shown to exhibit antitumor activity [3]. Another field of application of bithiazole derivatives includes synthesis of macrobicyclic cryptands [4].

Bithiazoles are usually prepared by heating under severe conditions of  $\alpha$ -halo ketones or ketones having another readily departing group in the  $\alpha$ -position [5] with thioamides or thioureas in the presence of a strong mineral acid (e.g., hydrobromic acid) [6]. These reactions are time-consuming [2, 7, 8], and the target products are obtained in low yields. In the preceding study we synthesized benzimidazole derivatives by reaction of *o*-phenylenediamine with ortho esters under microwave irradiation in the absence of solvent [9]. The present communication describes the synthesis of bithiazole derivatives under analogous conditions. The procedure is based on the condensation of thioamides or thiourea with  $\alpha$ -halo ketones under microwave irradiation in the presence of K10 mont-

morillonite as acid catalyst. 2,2'-Bithiazole derivatives were synthesized as follows: 2 equiv of  $\alpha$ -bromobenzyl or bromomethyl phenyl ketone was mixed with 1 equiv of dithioamide and 2 g of K10 montmorillonite. The mixture was thoroughly ground in a mortar, transferred into a beaker, and irradiated in a microwave furnace over a period indicated in table (2.5–6 min). After appropriate treatment, 2,2'-bithiazoles **IIa** and **IIb** were isolated in 60 and 75% yield, respectively (see table). 4,4'-Bithiazoles **IVa–IVc** were obtained in a similar way from the corresponding thioamides **IIIa–IIIc** and 1,4-dibromo-2,3-butanedione at a reactant ratio of 2:1. For comparison, compound **IIa** was also synthesized by conventional procedure: dithioamide was dissolved in anhydrous ethanol, the solution was transferred into a flask containing  $\alpha$ -bromo ketone **Ia**, and the mixture was heated for 18 h under reflux with stirring using a magnetic stirrer. The progress of the reaction was monitored by TLC. When the reaction was complete, the mixture was cooled to room temperature, and compound **IIa** was separated by filtration and recrystallized from benzene. Yield 24% [10].

Thus the proposed procedure ensures preparation of bithiazole derivatives in good yields without a solvent.



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Synthesis of 2,2'- and 4,4'-bithiazole derivatives under microwave irradiation without a solvent

Initial comp. no.	Product no.	Reaction time, min (power, %) <sup>a</sup>	Yield, <sup>b</sup> %	mp, °C (published data)
<b>Ia</b>	<b>IIa</b>	6 (70)	60	238–239 (238 [10, 11])
<b>Ib</b>	<b>IIb</b>	0.5 (100)+2 (50)	75	219–220 (222 [12])
<b>IIIa</b>	<b>IVa</b>	3 (100)	74	186–187 (187 [13])
<b>IIIb</b>	<b>IVb</b>	2 (100)+2 (70)	70	169–170 (167 [14])
<b>IIIc</b>	<b>IVc</b>	2 (100)+3 (70)	54	242 decomp. (240 decomp. [6, 7])

<sup>a</sup> The reaction time and irradiation power were optimized from the results of several experiments; 100% corresponds to 1000 W.

<sup>b</sup> Isolated product.

It takes a short time and is ecologically friendly. Unlike known methods, the reaction occurs under mild conditions and needs no catalysis by strong mineral acids.

All the products have been reported previously. They were identified by comparing their spectral parameters and physical properties with those of authentic samples. In all experiments, the progress of reactions was monitored by TLC. Compounds **IIa** and **IIb** exhibit fluorescent properties, and they are readily detected under UV light ( $\lambda$  366 nm). Initial  $\alpha$ -bromo ketones were prepared by addition of bromine in a dropwise manner to the corresponding carbonyl compounds, followed by heating under reflux until disappearance of the bromine color.

**4,4',5,5'-Tetraphenyl-2,2'-bithiazole (IIa)**. A mixture of 0.718 g (2.6 mmol) of  $\alpha$ -bromobenzyl phenyl ketone, 0.156 g (1.3 mmol) of dithiooxamide, and 2 g of K10 montmorillonite was thoroughly ground in a mortar, transferred into a beaker, and irradiated in a microwave furnace over a period of 6 min at a power of 70% (700 W). The mixture was then washed with ethanol to remove unreacted initial compounds, and the residue was extracted with methylene chloride. The extract was evaporated, and the crude product was washed with cold ethanol.

Compound **IIb** was purified by column chromatography on silica gel using methylene chloride–petroleum ether (1:1) as eluent. In the synthesis of bithiazole **IVa**, the reaction mixture was extracted with ethanol, the extract was kept in a refrigerator, and the precipitate was filtered off and washed with cold ethanol. In the synthesis of **IVb**, the reaction mixture was extracted with methanol, and the product was purified by recrystallization from aqueous (1:1) methanol. Compound **IVc** was extracted from the reaction mixture with warm ethanol, the extract was evaporated, and the crude product was washed with cold ethanol.

The <sup>1</sup>H and <sup>13</sup>C NMR spectra were recorded on a Bruker DRX-500 Avance spectrometer. The IR spectra were measured in KBr on an Unicam Matson 1000 Fourier spectrometer. The reaction mixtures were irradiated in a Butan M-245 domestic microwave furnace.

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