Synthesis of Functionalized Thiophene Based Pyrazole Amides via Various Catalytic Approaches: Structural Features through Computational Applications and Nonlinear Optical Properties

ABSTRACT

In the present study, pyrazole-thiophene-based amide derivatives were synthesized by different methodologies. Here, 5-Bromothiophene carboxylic acid (2) was reacted with substituted, unsubstituted, and protected pyrazole to synthesize the amide. It was observed that unsubstituted amide (5-bromo-N-(5-methyl-1H-pyrazol-3-yl)thiophene-2-carboxamide (7) was obtained at a good yield of about 68 percent. The unsubstituted amide (7) was arylated through Pd (0)-catalyzed Suzuki–Miyaura cross-coupling, in the presence of tripotassium phosphate (K_3PO_4) as a base, and with 1,4-dioxane as a solvent. Moderate to good yields (66–81%) of newly synthesized derivatives were obtained. The geometry of the synthesized compounds (9a–9h) and other physical properties, like non-linear optical (NLO) properties, nuclear magnetic resonance (NMR), and other chemical reactivity descriptors, including the chemical hardness, electronic chemical potential, ionization potential, electron affinity, and electrophilicity index have also been calculated for the synthesized compounds. In this study, DFT calculations have been used to investigate the electronic structure of the synthesized compounds and to compute their NMR data. It was also observed that the computed NMR data manifested significant agreement with the experimental NMR results. Furthermore, compound (9f) exhibits a better non-linear optical response compared to all other compounds in the series. Based on frontier molecular orbital (FMO) analysis and the reactivity descriptors, compounds (9c) and (9h) were predicted to be the most chemically reactive, while (9d) was estimated to be the most stable among the examined series of compounds.