Copper-Catalyzed Amidation of $\pi$-Excessive Heterocycles

Significance: Amino-substituted heterocycles are prevalent as subunits in a large number of pharmaceutical drug targets. As a result, transition-metal-catalyzed aryl C–N bond formation has been studied extensively. Traditionally, these compounds are synthesized by coupling heteroaryl halides with amine surrogates. Pan and co-workers report an efficient method for direct amidation of $\pi$-electron-rich heterocycles with N-fluorobenzenesulfonimide (NFSI). Interestingly, even though NFSI is typically used as a fluorinating reagent, no fluorinated byproducts are observed in this reaction. The procedure uses mild conditions to provide the desired functionalized products in high yields.

Comment: A variety of electron-deficient and electron-rich thiophenes, furans, and pyrroles undergo regioselective amidation under these reaction conditions. Although the reaction does proceed at ambient temperature, higher yields are obtained at slightly elevated temperature (60 °C). A mechanistic pathway involving copper(I), copper(II), and copper(III) species is proposed, and further studies to investigate the mechanism of this transformation are underway. For a recent method of 2-aminothiophene and other $\pi$-excessive heterocycle synthesis, see the copper(II)-catalyzed synthesis of 2-aminothiophenes from alkynoates and thioamides (Org. Biomol. Chem. 2014, 12, 8473; Synfacts 2015, 11, 24).

Representative examples:

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\begin{align*}
\text{88\% yield} & \quad \text{78\% yield} \\
\text{79\% yield} & \quad \text{73\% yield} \\
\text{86\% yield} & \quad \text{85\% yield} \\
\text{83\% yield} & \quad \text{76\% yield}
\end{align*}
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