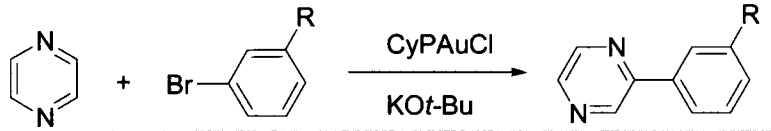
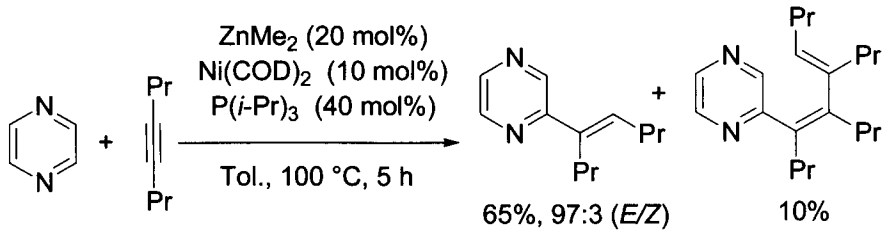
*tert*-butoxide and $Cy_3PAuCl$ were used in the reaction. This was accomplished when aryl bromides were treated with 5 equiv of pyrazine at 100 °C under the developed coupling procedure.




| R | Reaction Time (h) | Yield (%) |
|---|---|---|
| H | 24 | 82 |
| 2-methyl | 12 | 58 |
| 2-$CF_3$ | 24 | 31 |
| 4-OMe | 12 | 60 |

Direct C–H arylation on the pyrazine ring has also been accomplished using internal alkynes.[52] This reactivity has been attributed to the coordination of the Lewis acid to the nitrogen lone pair, increasing the acidity of the C(2)–H bond. This reaction was incredibly selective to provide the (*E*)-alkene (> 95:5). Dimethyl zinc was the most optimal catalyst used. When higher temperatures are used, an increased yield of the alkene was isolated, minimizing the amount of the dienylated product formed. When unsymmetrical alkynes are used the regioslectivity of the alkenylation is based upon the substituents off the starting alkyne. The end of the alkyne that bears the smaller substituent is the side that bonds to the aromatic ring while the larger substituent is selectively located in the *trans* position to the aromatic ring.




The use of trimethyl aluminum or lower reaction temperatures can slow the reductive elimination and/or promote the second insertion of additional alkynes into the carbon–nickel bond to give the dienylated product. One limitation to this reaction was that terminal alkynes were not applicable to this reaction due to rapid oligo/trimerization.

Nickel-catalyzed cross-coupling reaction like the Kumada coupling has been used to form biologically-active molecules. This coupling reaction has been described between fluoroarenes and aryl Grignard reagents with