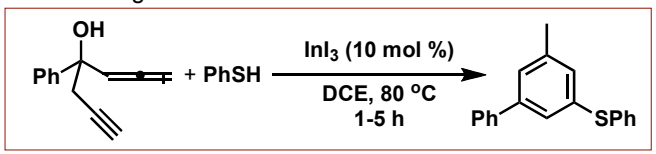
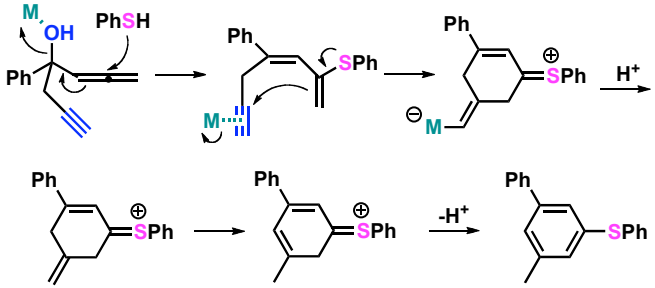
Metal-Catalyzed Reactions of Propargyl Allenic Alcohol with Thiophenols

Melody Campbell, Lingling Peng, Jie Ma, Zhe Zhang, Jianbo Wang*
Department of Chemistry, Peking University, University of Michigan

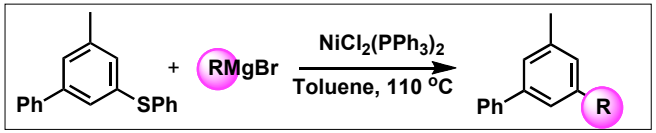
Introduction

Allenes and alkynes can be catalyzed to undergo a wide range of synthetically useful and efficient transformations. The products are exploited in total synthesis of natural products and pharmaceuticals. The transition-metal-catalyzed reaction of a propargyl allenic alcohol with a thiophenol is a novel way of affording a meta-substituted aromatic ring.



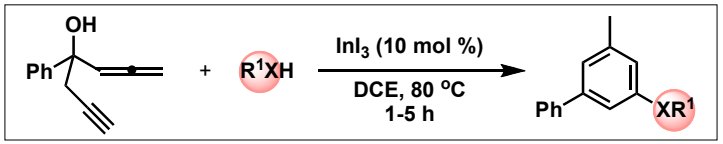


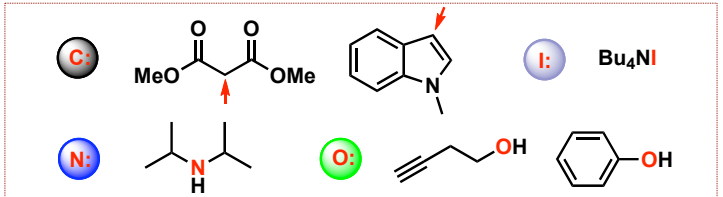
Coupling Reaction of Products



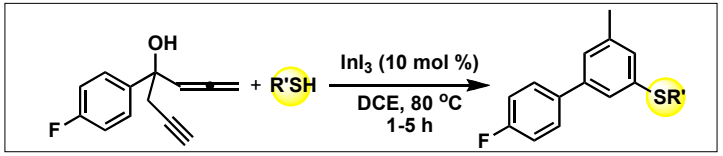
Substrate, R	Time (h)	Yield (%)
CH_3MgBr	7	77
PhMgCl	5	73
CH_2CH_2MgBr	22	No TM
$CHCCH_3MgBr$	22	No TM
$3\text{-}FC_6H_4MgBr$	5	95
$4\text{-}CH_3C_6H_4MgBr$	4.5	

Investigating Different Allenic Alcohols and Nucleophiles





All of the above nucleophiles had either no reaction, no targeted material, or a complex mix of products. Sulfur seems to play a key role in the reaction.



Our goal is to broaden the scope of this reaction by determining which reactants are capable of forming the product. This highly atomic-economic and efficient one-pot process can then be applied not only to the coupling reaction mentioned, but to improve in an extensive array of organic syntheses.

In the future we hope to further extend the applicability of this reaction by continuing the studies of varied nuclophiles as well as expanding the range by investigating the reactivity of propargyl esters as well as di-propargyl alcohols.

Substrate,R	Time (h)	Yield (%)
Ph	1	73
$4\text{-}ClC_6H_4$	1	66
$3\text{-}BrC_6H_4$	3	57
$3,4\text{-}Cl_2C_6H_3$	5	64
$2\text{-}CH_3C_6H_4$	1	56
$4\text{-}FC_6H_4$	1	82
$4\text{-}PhC_6H_4$	1	69
$3\text{-}MeOC_6H_4$	3	No TM
$PhCH_2CH_2$	1	45
$CH_3(CH_2)_5$	1	64

Substrate, R'	Time (h)	Yield (%)
Ph	1	82
$2\text{-}ClC_6H_4$	1	73
$2\text{-}BrC_6H_4$	1	77
$4\text{-}BrC_6H_4$	1	81
$2,6\text{-}Me_2C_6H_3$	5	60
$3\text{-}FC_6H_4$	1	92
$4\text{-}MeOC_6H_4$	1	88
naphthyl	1	79

Acknowledgments

We would like to thank all members of Prof. Wang's research group, the College of Chemistry and Molecular Engineering; Peking University, the Department of Chemistry at the University of Michigan, NSF, and the Chinese National Science Foundation for their generous support.