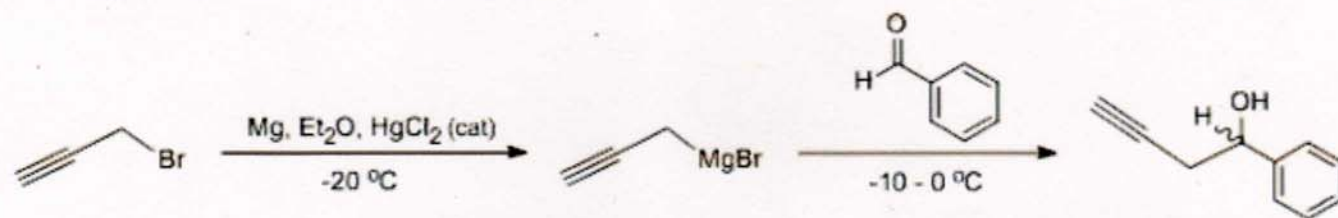


Addition of propargyl Grignard to aldehyde; 1-Phenyl-3-butyne-1-ol

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Chemicals Used

Propargyl bromide, HBC Chem, freshly distilled.

Magnesium turnings, chip, 99.8%, Sigma-Aldrich

Diethyl ether, anhydrous, 99.8%, Sigma-Aldrich, unless fresh material, dry just before use over sodium wire or lithium aluminum hydride.

Mercuric chloride, 98% or better, Sigma-Aldrich.

Benzaldehyde, 99.5%, Sigma-Aldrich, unless fresh material, distill before use.

Ammonium chloride, 99.5%, ACS reagent, Sigma-Aldrich

Procedure

An oven-dried one liter three-neck flask was equipped with a mechanical stirrer, heating mantle, dropping funnel, nitrogen inlet, Friedrich water condenser and calcium chloride drying tube. The flask was charged with 0.1 g of mercuric chloride, 24 g (1 mol) of magnesium turnings, 200 ml of dry diethyl ether and 1 g distilled propargyl bromide. The mixture was stirred, then gently warmed, until reaction commenced, as evidenced by vigorous ether reflux. The flask was then immersed in a dry ice/acetone bath maintained at approximately -20 °C. A solution of 46 g distilled propargyl bromide (0.40 mol) in 150 ml dry ether was then added drop-wise, with vigorous stirring, over a three hour period. The bath was maintained at approximately -20 °C. After the addition was complete, a solution of 26 g freshly distilled benzaldehyde (0.25 mol) in 150 ml of dry diethyl ether was added drop-wise over two hours, while maintaining bath temperatures of -10 to 0 °C. The mixture was allowed to come to room temperature and the contents of the flask were poured into a two liter beaker containing a well mixed slurry of ~ 500g crushed ice and ~ 500 g ammonium chloride. The mixture was stirred manually with the mechanical stirrer until two clear layers were present, and all excess magnesium chips and salts had dissolved. The upper ether layer was separated in a separatory funnel and the aqueous layer extracted twice in the separatory funnel with 50 ml ether portions. The combined ether layers were shaken twice with 25 ml deionized water portions and dried over anhydrous magnesium sulfate. Evaporation of the ether on a steam bath in a fume hood yielded a light yellow oil. Careful fractionation of the crude material in an oil bath under pump vacuum pressure (0.1 mm, ~ 110°C bath temperature), yielded 28 g of product (77% based on the amount of benzaldehyde used), which gave only a single G.C. peak, and which contained no isomeric internal acetylenic or allenic alcohols. The distilled material showed only one peak on both SE-30 and Triton-X-305 columns. Infrared spectra showed no trace of a characteristic strong allenic stretch at ~1950 cm⁻¹ and proton n.m.r. was devoid of peaks due to internal acetylenic

and allenic products.

Author's Comments

In order to avoid an internal rearrangement of the propargyl Grignard reagent, a modification of the procedure reported by Sondheimer (other reference), was utilized. Without this modification, a room temperature standard Grignard synthesis of 1-hexen-5-yne-3-ol (see lead reference), gave an approximate 50/50 mixture of desired product and the rearranged internal alkyne product 1-hexen-4-yn-3ol. This reaction gives reproducible yields in the 60-80% range as long as the instructions below are followed.

As with all Grignard syntheses, glassware should be dried in an oven before use, and the diethyl ether must be 99.9% or dried before use over sodium wire or lithium aluminum hydride.

Unsaturated carbonyl reactants should be distilled before use.

Mercuric chloride is toxic, and although used in very small quantities in these reactions latex gloves should be used when manipulating this material.

Diethyl ether is extremely flammable and open flames must be avoided near this material.

Many other acetylenic alcohols were prepared in fair to excellent yield by this procedure. See:

http://www.ccl.net/ccs/documents/MacMillan_Papers/Acetylenic_Alcohols.pdf

No trace of product alcohols resulting from rearrangement of propargyl Grignard to internal acetylenic or allenic species could be detected under these conditions. In contrast, room temperature reactions gave alcohol product mixtures resulting from the rearrangement of propargyl Grignards to internal alkynyl or allenyl Grignards. This synthetic modification is of great utility in preparation of alcohol precursors for annulene synthesis or acetylenic oxy-Cope rearrangements.

Data

b.p. 80 °C (0.5 mmHg), n_D^{26} 1.5457, d_4^{29} 1.0265, (lit : b.p. 89 °C (1 mmHg), n_D^{20} 1.5470.

Anal. Calc. For $C_{10}H_{10}O$: C, 82.16; H, 6.90.

Found: C, 82.10; H, 6.92

IR (neat film), 3400(s), 3300 (spike, s) 3030(m), 2900 (m), 2120 (w), 1600 (w), 1490 (s), 1450 (s), 1420 (m), 1390 (m), 1320 (m), 1205 (m), 1085 (m), 1050 (s), 1015 (s), 945 (m), 915 (m), 865 (m), 830 (w), 775 (m), 755 (s) and 700 (s) cm^{-1} .

1H NMR (60 Mhz, $CDCl_3$) δ 1.95 (t, 1H, acetylenic), 2.50 (dd, 2H, aliphatics), 3.50 (s, broad, 1H, OH), 4.70 (t, 1H, methine), 7.25 (5H, aromatics).

Lead Reference

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Other References

F. Sondheimer, Y. Amiel, and Y. Gaoni, J. Amer. Chem. Soc., 84, 270-274, (1962).

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Supplementary Information

[Acetylenic Alcohols.pdf](#)

Keywords: acetylenic alcohols, addition, alcohols, aldehydes, alkyl/alkenyl/aryl halides, alkynes, aromatics/arenes, Grignard reagents, ketones, propargyl magnesium bromide