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STEREOSPECIFIC SYNTHESIS OF DOUBLE BONDS VIA VINYLIC LITHIUM REAGENTS.

Gerard Linstrumelle[1]

Department of Chemistry, Massachusetts Institute of Technology, Cambridge,
Massachusetts 02139

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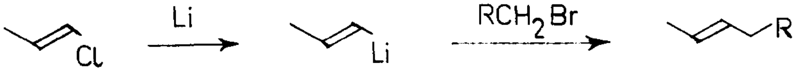
The stereospecific and stereoselective synthesis of double bonds has received a great deal of attention.[2,3] The carbon-carbon bond between a vinylic moiety and a hydrocarbon chain can be realized by several procedures. Organocuprates[4,5,6,7] are found to be efficient reagents; and under suitable experimental conditions, vinylic organocuprates can be alkylated with high yields.[8] A similar coupling reaction of organomagnesium reagents in tetrahydrofuran or in hexamethylphosphoramide has also been reported;[9] the efficiency of this reaction is considerably enhanced by addition of metal complexes.[10,11,12]

We have now found that vinylic lithium reagents can be alkylated by primary halides in high yields and with retention of configuration. Pure olefins were obtained and no elimination products (or less than 1%) from the primary halides were observed. However, with secondary halides, elimination became preponderant. Tetrahydrofuran was found to be the best solvent; in ether, the reaction was very slow.



This procedure utilizes the organolithium component more efficiently than does R_2CuLi since all of the organolithium moieties present in solution are available for reaction. The yield difference (theoritical 100% based on RLi, theoritical 50% based on R_2CuLi, practically often less for the latter because of the requirement for excess organometallic) is the most useful and novel feature of this process.

Our coupling reaction has been studied with trans-1-propenyl lithium (containing 3% of cis isomer, as shown by reaction with dibromoethane), obtained from (100% trans)-1-propenyl chloride. The results of the coupling reaction with octyl halides are summarized in table 1: 2-undecene (containing 4% of cis isomer) was obtained.

Different mixtures of cis and trans 1-propenyl lithium gave corresponding proportions of cis and trans-2-undecene. The lithium reagent showed a decreasing reactivity with the halides in the order: iodide $\rangle$ bromide $\rangle$ chloride.

Since pure cis and trans vinylic halides are readily obtainable[13] and converted into vinylic lithium reagents, this procedure represents an efficient olefin synthesis.

Further work on the synthetic utilization of this reaction is in progress.

Table 1

Trans-2-undecene prepared from 1 equivalent of propenyl lithium with 1 equivalent of the following substrates

Substrate	Solvent	Yield,[a] %	Time, hr	Temperature, °C
1-iodooctane	tetrahydrofuran	100	1.7	+25
	ether	7	23	+25
	ether + HMPA	60	0.25	-35
1-bromooctane	tetrahydrofuran	100	3.5	+25
1-chlorooctane	dimethoxyethane	50[b]	70	+25
1-tosyloctane	tetrahydrofuran	0	48	+25

[a] Yields are determined by glpc (12-ft, 15% 1,2,3 tris (2-cyanoethoxy) propane) (TCEP), using a calibrated internal standard. After isolation of the olefin, on

preparative scale, yields are usually inferior, *ca.* 10%. [b]Unreacted chloride (40%) remains after the end of the reaction.

Typical procedure: Trans-2-undecene. To 71 ml of *trans*-1-propenyl lithium[8,14,15] in ether (1.04 *N*, 0.738 mol), 120 ml of anhydrous tetrahydrofuran are added under argon. The flask is cooled in a rock salt-ice bath and 12.1 ml (13.51 g, 0.07 mol) of pure 1-bromooctane are added, drop by drop, by syringe. After the end of the addition, the cool bath is removed and the solution is allowed at room temperature for 5 hr. An aliquot, hydrolyzed, and analyzed by glpc, shows that all the bromide has reacted. Work-up in the usual manner gives 9,68 g (89.8%) of *trans*-2-undecene, bp 88° (17mm), containing *ca.* 4% of *cis*-2-undecene, n_D^{25}= 1.4276 (lit.[16] bp 75.5° (10mm), n_D^{25}= 1.4272); ir (neat) 3020, 1655, 965 cm^{-1}; nmr (CCl_4) δ 0.9 (3H, m), 1.6 (3H, m), 5.2-5.5 (2H, m).

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