Reaction of Lithium Dialkylcuprates with β-Alkoxy and β-Alkylthio αβ-Unsaturated Carbonyl Compounds

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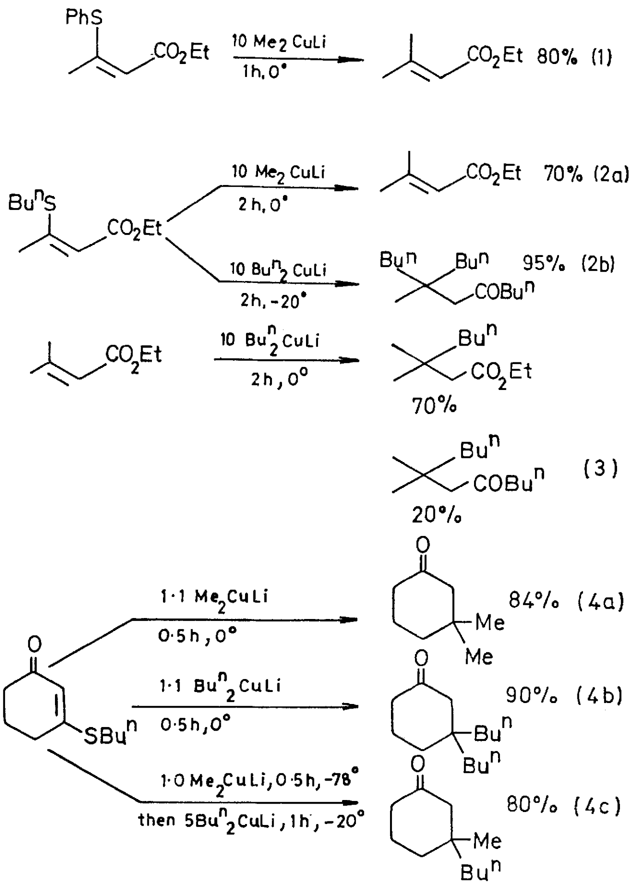
Summary β-Alkoxy- and β-alkylthio-αβ-ethylenic esters and ketones are converted in high yield into β-alkyl-αβ-ethylenic esters and into ββ-dialkyl ketones using lithium dialkylcuprate reagents.

A recent report[1] and the current general interest in reactions of organometallic reagents with β-amino-,[2] β-alkoxy-,[3] β-thioalkoxy-,[4] and β-chloro-[5]αβ-unsaturated carbonyl compounds prompts us to report our results in this area. We have treated a variety of β-heteroatom substituted αβ-ethylenic esters and ketones with lithium dialkylcuprate reagents in diethyl ether under inert atmosphere. In all cases, the β-hetero substitent is replaced by an alkyl group from the dialkylcuprate reagent; whereas the β-alkyl enoate esters formed in these reactions generally do not react further with lithium dimethylcuprate, the β-alkyl enone intermediates undergo a conjugate addition reaction[6] to produce ββ-disubstituted ketones. The results are summarized in equations (1)—(4).

Although replacement of a β-phenylthio-group [equation (1)] or a β-butylthio-group [equation (2a)] in an αβ-ethylenic ester is achieved effectively using lithium dimethylcuprate, the more reactive lithium di-n-butylcuprate converts the initially formed ββ-dialkylacrylate ester into the corresponding β-n-butyl ketone [equations (2b) and (3)]; this reaction most likely proceeds first by conversion of the enoate ester into the corresponding ethylenic ketone[7] and then by conjugate addition of an n-butylcopper reagent.† Thus despite the broad utility of alkylcopper reagents in conjugate addition reactions,[6] these reagents are not generally useful for converting ββ-dialkylacrylate esters into βββ-trialkylacetates.

β-Acetoxy-αβ-ethylenic ketones are converted into β-methyl enones using 1·0 equiv. of lithium dimethyl-



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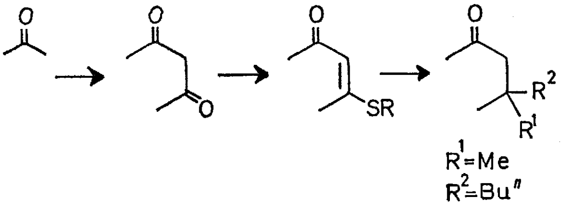
† Organocopper reagents undergo conjugate addition to enones more easily than to enoate esters: see ref. 6.

cuprate at −78° and into $\beta\beta$-dimethyl ketones using 2·7 equiv. of this reagent.[1] In contrast, we find that 3-ethoxycyclohex-2-enone reacts with a large excess of lithium di-n-butylcuprate at 0° to form mainly 3-n-butylcyclohex-2-enone and little 3,3-di-n-butylcyclohexanone. In further contrast, β-n-butylthiocyclohexenone reacts with only 1·1 equiv. of lithium dialkylcuprate reagent at 0° to produce the corresponding $\beta\beta$-diadduct and no β-alkyl enone [equations (4a) and (4b)]. The sensitivity of these reactions to temperature is indicated by equation (4c), in which two different alkyl groups have been attached to the carbon atom β to the carbonyl group.



(5) 85%

The overall transformation outlined in equation (5) thus allows replacement of one carbonyl oxygen atom in symmetrical 1,3-diketones by two different alkyl groups,[8] and it allows α-tertiary alkylation of ketones.[9]

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