# Iodomethylzinc Iodide[1]

$ICH_2ZnI$

(**1**; $ICH_2ZnI$)
*[4109-94-8]* $CH_2I_2Zn$ (MW 333.22)
InChI = 1/CH2I.HI.Zn/c1-2;;/h1H2;1H;/q;;+1/p-1/fCH2I.I.Zn/h;1h;/q;-1;m/rCH2I2Zn/c2-1-4-3/h1H2
InChIKey = IVHZANOQGCIPSI-BRAXOHAHCB
(**2**; $BrCH_2ZnBr$)
*[4109-95-9]* $CH_2Br_2Zn$ (MW 239.22)
InChI = 1/CH2Br.BrH.Zn/c1-2;;/h1H2;1H;/q;;+1/p-1/fCH2Br.Br.Zn/h;1h;/q;-1;m/rCH2Br2Zn/c2-1-4-3/h1H2
InChIKey = GHOUDIFZDOXZAS-ZZCKOOIYCY
(**3**; $(ICH_2)_2Zn$)
*[14399-53-2]* $C_2H_4I_2Zn$ (MW 347.25)
InChI = 1/2CH2I.Zn/c2*1-2;/h2*1H2;/rC2H4I2Zn/c3-1-5-2-4/h1-2H2
InChIKey = SQWSDUFCDSOBRK-ZYOQDUGOAC
(**4**; $(ICH_2)_2Zn{\cdot}DME$)
*[131457-21-1]* $C_6H_{14}I_2O_2Zn$ (MW 437.39)
InChI = 1/C4H10O2.2CH2I.Zn/c1-5-3-4-6-2;2*1-2;/h3-4H2,1-2H3;2*1H2;/rC4H10O2.C2H4I2Zn/c1-5-3-4-6-2;3-1-5-2-4/h3-4H2,1-2H3;1-2H2
InChIKey = MMDWDMHVWQCXCP-ALKJGBHIAJ
(**5**; $(BrCH_2)_2Zn$)
*[92601-82-6]* $C_2H_4Br_2Zn$ (MW 253.25)
InChI = 1/2CH2Br.Zn/c2*1-2;/h2*1H2;/rC2H4Br2Zn/c3-1-5-2-4/h1-2H2
InChIKey = BHGCVEDWHVMQES-FCTCVDBLAB
(**6**; $(ClCH_2)_2Zn{\cdot}DME$)
*[131457-22-2]* $C_6H_{14}Cl_2O_2Zn$ (MW 254.49)
InChI = 1/C4H10O2.2CH2Cl.Zn/c1-5-3-4-6-2;2*1-2;/h3-4H2,1-2H3;2*1H2;/rC4H10O2.C2H4Cl2Zn/c1-5-3-4-6-2;3-1-5-2-4/h3-4H2,1-2H3;1-2H2
InChIKey = NSFGXDMAKSBLIT-URNAQKTCAV

(methylene transfer reagent: cyclopropanates alkenes,[1] *a1/d*[1] multicoupling reagent,[2] transmetalation with various metal halides affords other iodomethylmetal compounds[3])

*Alternate Name:* Simmons–Smith reagent.

*Physical Data:* an X-ray crystal structure of $(ICH_2)_2Zn$ complexed to a glycol bis-ether is known;[4] DME complexes of $(ICH_2)_2Zn$ and $(ClCH_2)_2Zn$ and an acetone complex of $(ICH_2)_2Zn/ZnI_2$ have been characterized by NMR spectroscopy;[4] $^1H$ NMR spectra attributed to THF complexes of $BrCH_2ZnBr$ and $(BrCH_2)_2Zn$ have been reported.[5]

*Solubility:* $ICH_2ZnI$ generated from either $CH_2I_2$/Zn–Cu couple or EtZnI/$CH_2I_2$ is generally prepared in ethereal solvents ($Et_2O$, DME). The $Et_2Zn/CH_2I_2$ method of reagent generation can utilize noncoordinating solvents ($CH_2Cl_2$, $ClCH_2CH_2Cl$, toluene, etc.).

*Preparative Methods:* the two most widely used methods of preparing halomethylzinc reagents are the Simmons–Smith and Furukawa procedures, utilizing ***Diiodomethane/Zinc/Copper Couple*** and $CH_2I_2$/***Diethylzinc*** (or ***Chloroiodomethane***/-$Et_2Zn$),[6] respectively. The reagent is often prepared in the presence of the substrate (usually an alkene). Various methods of reagent preparation are discussed below. The precursors are widely available.

# Original Commentary

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**Reagent Preparation.** There are a number of protocols for generating iodomethylzinc reagents, which can be categorized into three general classes: type 1, the oxidative addition of a dihalomethane to zinc metal, as typified by the original Simmons–Smith procedure;[7,8] type 2, the reaction of a zinc(II) salt with a diazoalkane, first reported by Wittig and co-workers;[9] and type 3, an alkyl exchange reaction between an alkyl zinc and a 1,1-dihaloalkane, often referred to as the Furukawa procedure.[10]

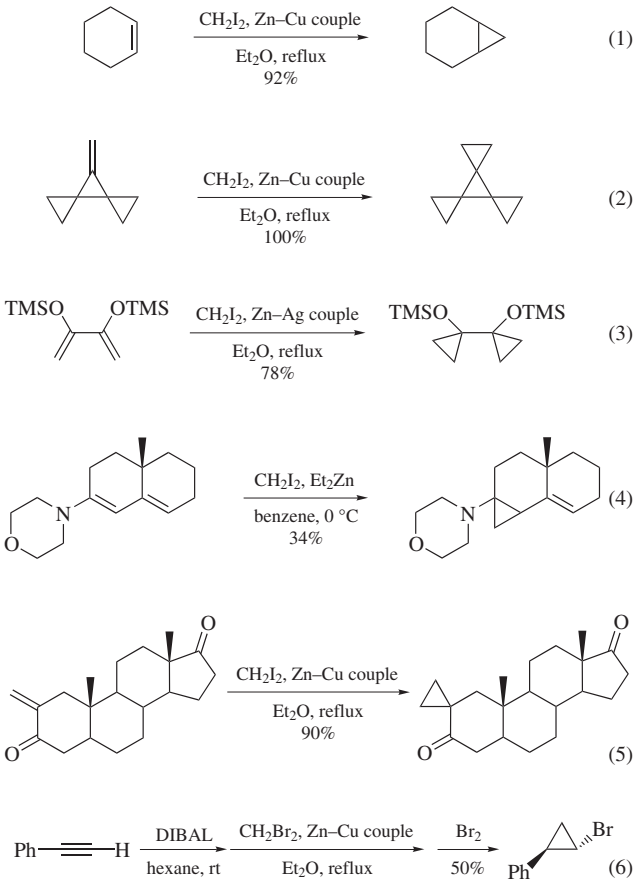
Type 1 reagent generation has been used most often in synthetic contexts due to the ease with which the reagent precursors can be handled. Although the initial method of preparation of the Zn–Cu couple was difficult and not easily reproducible,[7] several simpler and highly reproducible methods soon followed.[11] Treatment of the Zn–Cu couple with $CH_2I_2$ and a crystal of ***Iodine*** in $Et_2O$ followed by heating to reflux generates the active reagent. Other modifications include the use of $CH_2I_2$/Zn/CuCl,[12a] $CH_2I_2$/Zn–Ag couple,[12b] $CH_2Br_2/Zn/TiCl_4$,[12c] and $CH_2Br_2$/Zn/AcCl/CuCl.[12d]

Type 2 reagent generation has been utilized much less frequently. The method consists of the treatment of an ethereal suspension of a zinc(II) salt ($ZnCl_2$, $ZnBr_2$, $ZnI_2$, or $Zn(OBz)_2$) with $CH_2N_2$ or an aryldiazomethane.[9a]

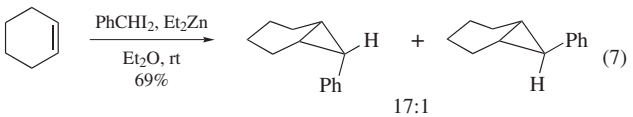
Type 3 halomethylzinc generation (originally reported in 1966)[10a] involves treatment of a solution ($Et_2O$, hexane, toluene, etc.) of $Et_2Zn$ with $CH_2I_2$ to generate the reagent. The use of a 2:1 ratio of $CH_2I_2$ to $Et_2Zn$ generates $(ICH_2)_2Zn$,[4] while a 1:1 ratio presumably generates $EtZnCH_2I$.[10] The reaction is accelerated by the presence of trace amounts of oxygen.[6b] Treatment of $Et_2Zn$ with substituted diiodides, such as benzylidene and ethylidene iodide, also gives rise to active cyclopropanating reagents.[13] Recently, the substitution of $ClCH_2I$ for $CH_2I_2$ and the use of $ClCH_2CH_2Cl$ (DCE) as the reaction solvent has been demonstrated to provide a more reactive reagent for certain applications.[6a] In addition, the combination of EtZnI and $CH_2I_2$ has also been shown to provide $ICH_2ZnI$, thus avoiding the need for the highly pyrophoric $Et_2Zn$.[14]

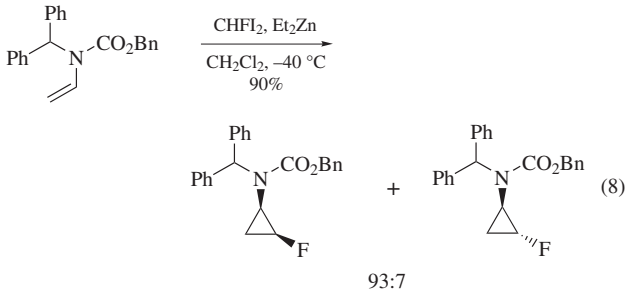
**Cyclopropanations.** The cyclopropanation of alkenes utilizing halomethylzinc reagents ($ICH_2ZnI$ being the prototypical reagent), known as the Simmons–Smith reaction,[7] has proven to be an extremely versatile and general reaction. Typical examples of alkenes that have been successfully cyclopropanated are provided in eqs 1–5. A variety of isolated alkenes have been cyclopropanated with the Simmons–Smith reagent (e.g. eq 1),[1a,12b] and $ICH_2ZnI$ provides for a unique preparation of numerous spiro derivatives (eq 2).[15] Electron-rich alkenes such as enol ethers (eq 3)[16a–c] and enamines (eq 4)[16d,e] also have been found to be good substrates under the proper conditions, as have certain

steroidal enones (eq 5).[16f,g] Simmons–Smith reagents thus have been demonstrated to cyclopropanate alkenes ranging from electron rich to electron deficient. This contrasts with the analogous reagents generated from $CH_2I_2/R_3Al$[17] and $ClCH_2I/Sm(Hg)$:[18] the former reacts preferentially with isolated alkenes, while the latter cyclopropanates allylic alcohols almost exclusively. Certain vinyl metal species (Al, Si, Ge, Sn, B) can also be cyclopropanated with some success with the Simmons–Smith reagent.[19] For example, vinylalanes produced in situ from alkynes and ***Diisobutylaluminum Hydride*** react readily with $CH_2Br_2$/Zn–Cu couple; the intermediate cyclopropylalanes react with bromine to produce cyclopropyl bromides (eq 6).[19b] Generally, the reaction is most successful with electron-rich alkenes, indicative of the electrophilic nature of halomethylzinc reagents.[1a]

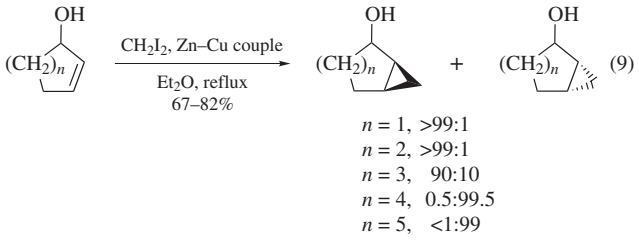


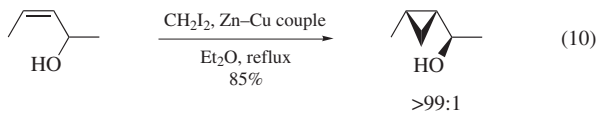

The reaction is not limited to unsubstituted methylene transfers.[13] The combination of $MeCHI_2$[13a–c] or $PhCHI_2$[13a,d] with $Et_2Zn$ also provides active cyclopropanation reagents. The diastereoselectivity is highly substrate dependent, but good diastereoselectivity can be achieved in certain cases (eq 7), particularly with cyclic alkenes. The stereoselectivity is solvent dependent, with ethereal solvents affording the higher levels of selectivity.[13d] Halogen-substituted carbenoids can also be prepared from various $XCHI_2$ (X = I, Br, F) or $X_2CHI$ (X = Br, Cl) and $Et_2Zn$ (eq 8).[13e–g]

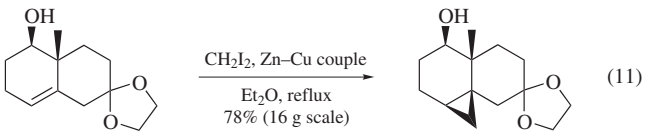


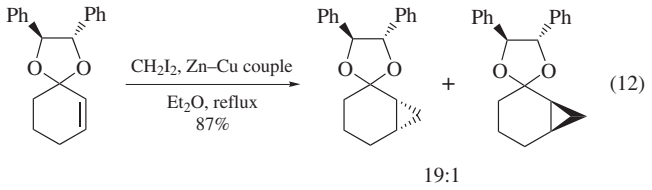

Perhaps the most intriguing aspect of the Simmons–Smith reaction is the strong accelerating and stereodirecting effect of oxygen functions proximal to the alkene. First discovered in 1959,[20] this reaction has been often utilized in synthetic efforts[21] and the reaction itself has been the subject of several investigations.[22] For example, cyclopropanation of 2-cyclohexen-1-ol provides the *syn*-cyclopropane almost exclusively.[22a] A study of various cyclic allylic alcohols demonstrates the generality of the effect (eq 9):[22c] the larger rings afford *trans* adducts due to conformational effects. The diastereoselectivity of the cyclopropanation of acyclic secondary allylic alcohols depends upon the configuration of the alkene. *cis*-Alkenes react with diastereoselectivities of >99:1 (eq 10), while *trans*-alkenes react with much less selectivity (<2:1).[22f] Homoallylic alcohols also show a similar directing effect in certain cases (eq 11).[20,21e]



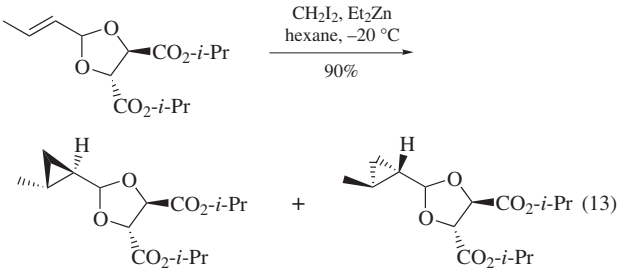



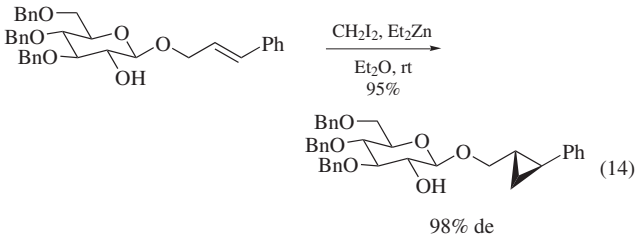

Chiral auxiliary mediated cyclopropanations which exploit this oxygen-directing effect have recently been developed. The first Simmons–Smith reactions exhibiting effective diastereofacial control by chiral auxiliaries were reported simultaneously by two groups in 1985.[23,24] Chiral acetals derived from cyclic enones undergo highly diastereoselective cyclopropanations upon treatment with $CH_2I_2$/Zn–Cu couple (eq 12). Acyclic enones are cyclopropanated with greatly attenuated diastereoselectivity.



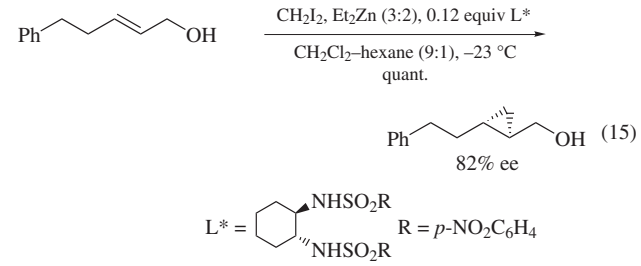

Similarly, chiral acetals[24] derived from $\alpha,\beta$-unsaturated aldehydes and diisopropyl tartrate are cyclopropanated in a highly diastereoselective manner by $CH_2I_2/Et_2Zn$ (eq 13). Diastereoselectivities are uniformly high for dioxolane acetals derived from *trans*-disubstituted $\alpha,\beta$-unsaturated aldehydes, but acetals derived from $\alpha,\beta$-unsaturated ketones react less selectively, as do 2-alkenyl-1,3-dioxane acetals.



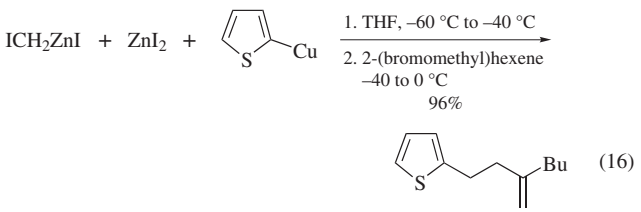

A related oxygen-directed cyclopropanation has also been reported.[25] Vinyl boronates derived from tartaric esters or amides were shown to undergo highly diastereoselective cyclopropanations upon treatment with $CH_2I_2$/Zn–Cu couple. These adducts were conveniently converted to enantiomerically enriched cyclopropanols. The carbohydrate 2-hydroxy-3,4,6-tri-*O*-benzyl-$\beta$-D-glucopyranose appended to an allylic alcohol also functions as an effective chiral auxiliary, affording cyclopropanes with extremely high levels of diastereoselectivity (eq 14).[26] Other chiral auxiliaries have also been shown to direct halomethylzinc cyclopropanations with good to excellent stereocontrol.[13g,27]

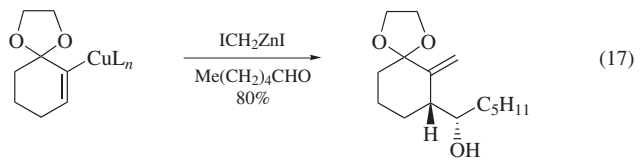


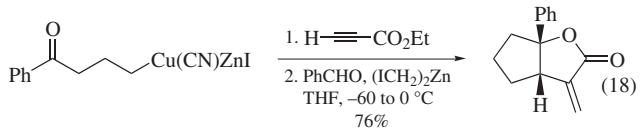

Although the potential for preparing enantioselective halomethylzinc reagents was recognized early on,[28] only since 1992 have encouraging levels of enantioselectivity been observed.[29] The best results reported to date utilize chiral $C_2$-symmetric sulfonamides in substoichiometric amounts as the source of chirality (eq 15).[29a] A zinc complex of this ligand is proposed to act as a chiral Lewis acid catalyst in this reaction. All of the enantioselective halomethylzinc cyclopropanations reported to date utilize allylic alcohols as substrates, and the free hydroxy group appears to play an essential role.[29]




**Methylene Homologation Reactions.** The carbon bound iodine atom of $ICH_2ZnI$ can be easily displaced by nucleophiles to generate new organozinc reagents.[9b] For example, various copper nucleophiles displace the carbon bound iodine from $ICH_2ZnI$ or $(ICH_2)_2Zn$, generating new organometallic reagents that react with allyl halides.[2,30] Copper nucleophiles such as CuCN/LiCl, $NCCH_2Cu$, copper amides, vinylcoppers, and heteroarylcopper compounds all participate in this reaction (eq 16). This reaction has proven to be especially useful for the conversion of alkenylcoppers into allylic copper–zinc reagents which react with aldehydes affording homoallylic alcohols (eq 17). An expedient route to $\alpha$-methylene-$\gamma$-butyrolactones that exploits this behavior has also been developed (eq 18).[30e]



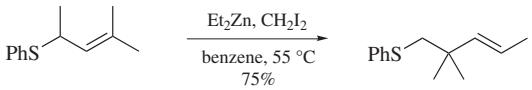




**Transmetalation Reactions.** Like other alkylzinc reagents,[31] halomethylzinc reagents have also been shown to participate in transmetalation reactions.[3,14a] This methodology provides an expedient route to iodomethylmercury and iodomethyltin compounds. For example, treatment of $Me_3SnCl$ with $ICH_2ZnI$ derived from EtZnI and $CH_2I_2$ provides $Me_3SnCH_2I$ in 78% yield.[14a] $Bu_3SnCH_2I$ may be prepared similarly in 96% yield.[32] Substituted diiodides also provide zinc reagents that participate well in this reaction.[14a]

**[2,3]-Rearrangements.** A method for the generation of sulfur ylides from allylic phenyl sulfides and $CH_2I_2/Et_2Zn$ has been described.[33] The intermediate sulfur ylides undergo a sigmatropic

[2,3]-rearrangement affording homoallylic sulfides (eq 19). The reaction gives (*E*)-alkenes selectively.




(19)

# First Update

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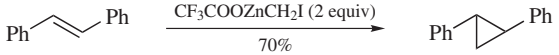
**Preparation of Modified Iodomethylzinc Carbenoids.** Several useful variations of the traditional Simmons-Smith reagent involving the change of the Y group in $YZnCH_2I$ have been reported. A very useful modification consists of using the reagent prepared by mixing trifluoroacetic acid, diethylzinc, and diiodomethane to presumably form $CF_3COOZnCH_2I$.[34] Care should be taken when adding trifluoroacetic acid to diethylzinc because of the exothermicity of the reaction. This reagent is particularly effective for the cyclopropanation of less reactive alkenes such as styrene and *cis*- and *trans*-stilbene (eqs 20 and 21); however, the reagent by-products are somewhat more Lewis acidic than those resulting from the Furukawa reagent ($EtZnCH_2I$), and sensitive compounds are not tolerated. Other reagents derived from less acidic carboxylic acids and relatively acidic primary alcohols have been made, but they show lower reactivities.[35]

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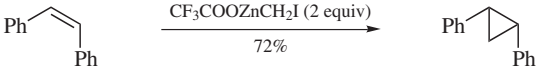
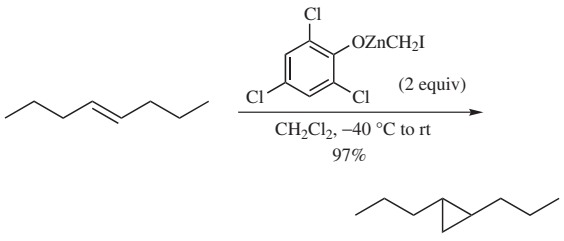


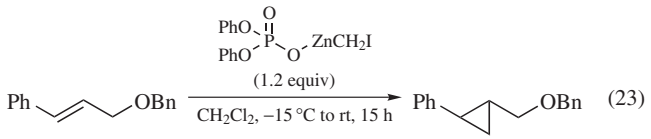

(21)

Reagents derived from $ArOZnCH_2I$ have also been prepared and were found to be quite reactive for the cyclopropanation of alkenes, especially when the aryl group is substituted with halogens.[36] The reagent derived from 2,4,6-trichlorophenol converts alkyl- and aryl-substituted alkenes into the corresponding cyclopropanes in high yield (eq 22).



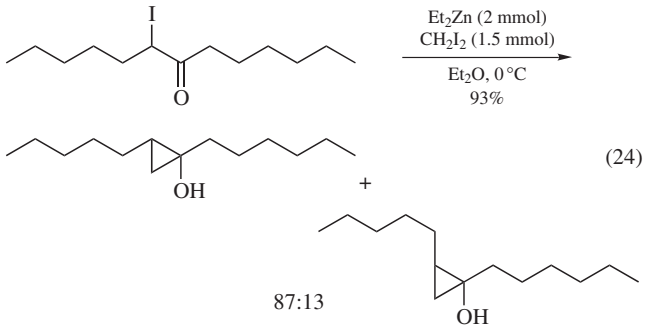

(22)

Iodomethylzinc diphenylphosphate has also been prepared by mixing diphenylphosphoric acid, diethylzinc, and diiodomethane.[37] Although the iodomethylzinc phosphate reagents are not quite as reactive as those described above, they exhibit a much greater stability (eq 23). For example, iodomethylzinc diphenylphosphate is a relatively stable solid that can be stored for several weeks under argon at 5 °C without losing its activity.



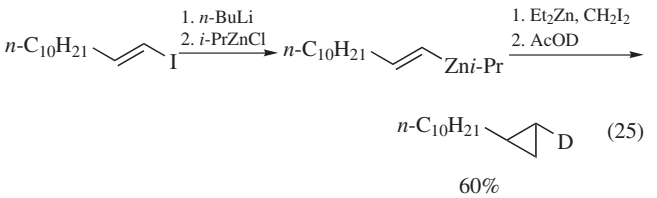

(23)

**Cyclopropanation of Organozinc Substrates.** The reaction of zinc enolates, prepared from α-iodoketones and diethylzinc, with a mixture of diethylzinc and diiodomethane generated the corresponding cyclopropanols in good yield (eq 24).[38] The yields obtained were much superior to those observed with boron or aluminum enolates; however, a mixture of the two diastereomeric cyclopropanes is usually observed.




(24)

The cyclopropanation of 1-alkenylzinc derivatives has been achieved by sequential treatment of (*E*)- or (*Z*)-1-iodoalkenes with *n*-BuLi and isopropylzinc chloride followed by diethylzinc and diiodomethane (eqs 25 and 26).[39] Alternatively, the 1-alkenylzinc intermediate can be prepared from the 1-alkenylzirconium intermediate obtained by hydrozirconation of an alkyne. It should also be pointed out that under similar conditions the use of the Simmons-Smith reagent ($IZnCH_2I$) leads to an allylzinc species instead of a cyclopropanation.[40]

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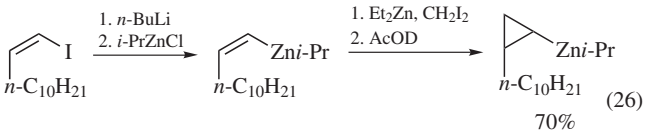



(26)

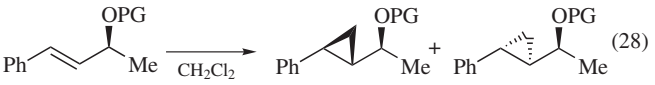
**Cyclopropanation of Chiral Alkenes.** The cyclopropanation of chiral alkenes has been thoroughly studied to optimize diastereoselectivities. Although it is well established that the cyclopropanation of chiral cyclic alcohols using any of the zinc carbenoids proceeds with high *syn* stereocontrol, the cyclopropanation of chiral, acyclic allylic alcohols can be tuned to afford

either the *syn*- or the *anti*-isomer. A survey of known zinc reagents resulted in the finding that 5 equiv of the Furukawa reagent in dichloromethane led to a very high *syn*-selectivity.[41] This selectivity was much superior to that obtained with the Simmons-Smith reagent in diethyl ether (eq 27).[42]

(27)

| | | |
|---|---|---|
| $IZnCH_2I$, ether | - - - | <2:1 |
| $EtZnCH_2I$ (5 equiv), $CH_2Cl_2$ | 86% | 7:1 |
| $Zn(CH_2I)_2$ (5 equiv), $CH_2Cl_2$ | >95% | 3.2:1 |

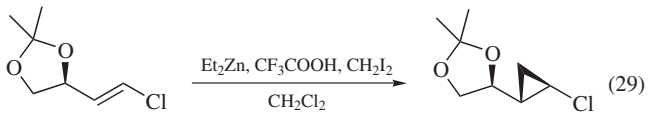
An *anti*-selective cyclopropanation of *E*-substituted acyclic chiral allylic ethers could be accomplished on both a benzyl- or silyl-protected allylic alcohol, but the more reactive Shi reagent must be used to overcome the absence of a directing group in the latter case (eq 28).[43]



(28)

| | | |
|---|---|---|
| PG = Bn, $EtZnCH_2I$ (5 equiv) | 94% | 10:90 |
| PG = TIPS, $CF_3COOZnCH_2I$ (2 equiv) | 88% | >99:1 |
| PG = TBDMS, $CF_3COOZnCH_2I$ (2 equiv) | 86% | 98:2 |
| PG = TES, $CF_3COOZnCH_2I$ (2 equiv) | 87% | >99:1 |

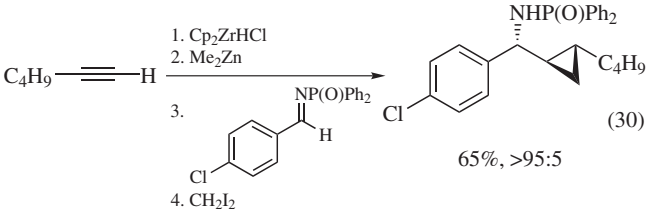
Care should be exercised, however, since the nature of the substituents on the alkene can have a huge impact on the sense of induction. Acetal-protected chloroallyl ethers can lead to the *syn*-isomer with an excellent ratio (eq 29).[44] This reaction was used as the key step in the preparation of the callipeltoside A side chain.



(29)

82%, >99:1

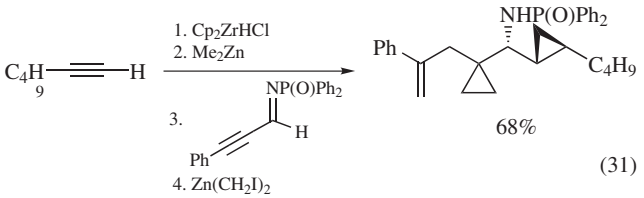
The cyclopropanation of protected chiral allylic amines can also be achieved by a sequential hydrozirconation/transmetallation/imine addition/cyclopropanation (eq 30).[45,46] However, there is no enantioselective version of this reaction to date.



(30)

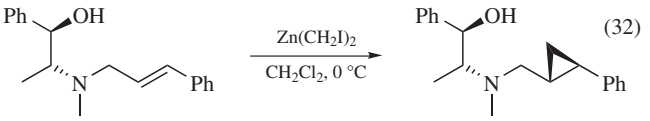
65%, >95:5

It is also possible to use the same reagents in a cascade process leading to the sequential formation of nine carbon-carbon bonds (eq 31).[47]



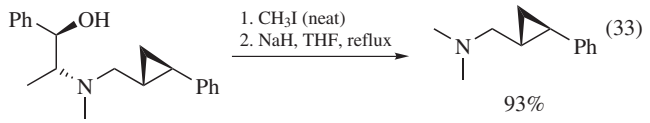
(31)

A chiral auxiliary-based approach has been developed for the preparation of chiral, nonracemic cyclopropylmethylamines. The cyclopropanation of allylic tertiary amines bearing a $\beta$-hydroxy group occurs very cleanly and with high diastereocontrol to generate the cyclopropylmethylamine (eq 32).[48] Cleavage of the auxiliary can be achieved upon treatment with methyl iodide followed by heating (eq 33).



(32)

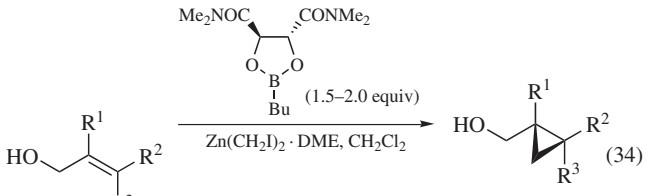
95%, >98:2



(33)

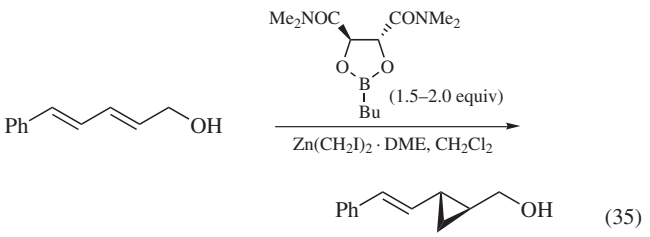
93%

**Asymmetric Cyclopropanation of Alkenes with Stoichiometric Chiral Ligands and Reagents.** The most widely used method for the preparation of enantiomerically enriched cyclopropylmethanol derivatives is the dioxaborolane-mediated cyclopropanation of allylic alcohols with bis(iodomethyl)zinc·DME complex (eq 34).[49] The boron ligand is easily prepared from butylboronic acid and tetramethyltartramide.[50] The method has been extended to the chemoselective cyclopropanation of polyenes containing an allylic alcohol subunit (eq 35),[51] of allenyl alcohols (eq 36),[52] as well as chiral allylic alcohols.[53] It has also been extensively applied in natural product synthesis, such as FR-900848,[54] U-106305,[55,56] curacin A,[57] and callipeltoside, A.[58]



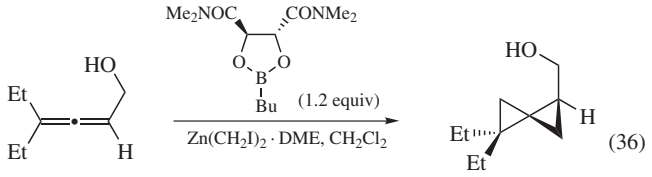
(34)

>71%, 82–94% ee



(35)

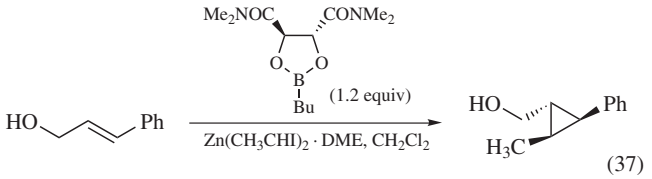
mono:bis > 20:1
84%, 91% ee




(36)

70%, 97% ee

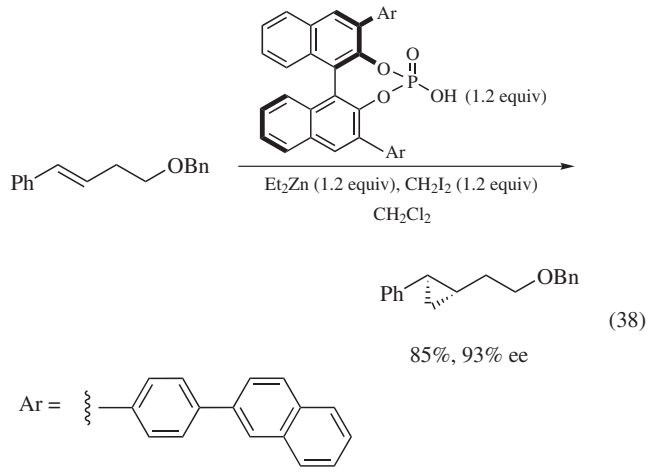
It is also possible to use $\alpha$-substituted iodoalkylzinc reagents in the presence of the chiral dioxaborolane ligand to generate 1,2,3-substituted cyclopropanes in high yield and stereocontrol (eq 37).[59] However, the reaction requires a large excess of 1,1-diiodoethane (4 equiv) and diethylzinc (2 equiv).




(37)

96%, >50:1 dr, 98% ee

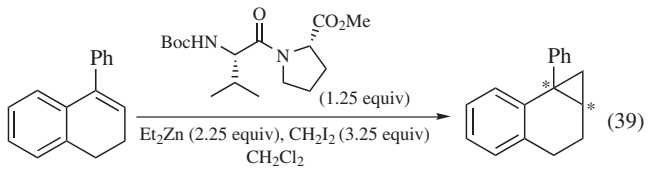
The cyclopropanation of homoallylic alcohols with the chiral dioxaborolane ligand does not generally proceed with high enantiocontrol (<80% ee); however, the use of a chiral phosphate reagent derived from 3,3′-disubstituted binols gave good enantiocontrol with (*E*)-aryl substituted homoallylic benzyl-protected alcohols (eq 38).[37]




(38)

85%, 93% ee

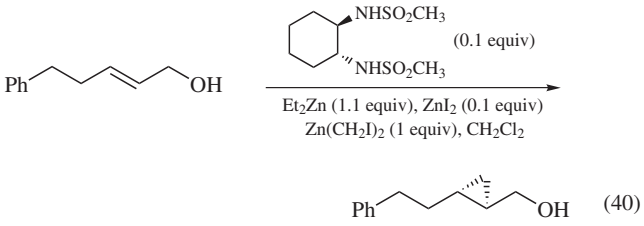
The enantioselective cyclopropanation of unfunctionalized alkenes using chiral iodomethylzinc reagents is quite limited in scope. However, it has been shown that aryl-substituted alkenes can be converted into cyclopropanes with good enantiocontrol in the presence of a simple dipeptide (eq 39).[60]




(39)

83%, 90% ee

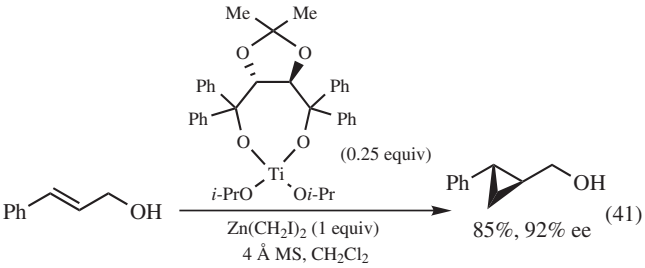
**Catalytic, Asymmetric Cyclopropanation of Alkenes.** Four effective methodologies are currently available for the catalytic, asymmetric cyclopropanation of alkenes using iodomethylzinc reagents. The first system that was developed for the catalytic asymmetric cyclopropanation of allylic alcohols was based on the use of a disulfonamide ligand derived from 1,2-diaminocyclohexane.[61] The scope and efficiency of the cyclopropanation was significantly improved upon the addition of $ZnI_2$ to the reaction mixture (eq 40).




(40)

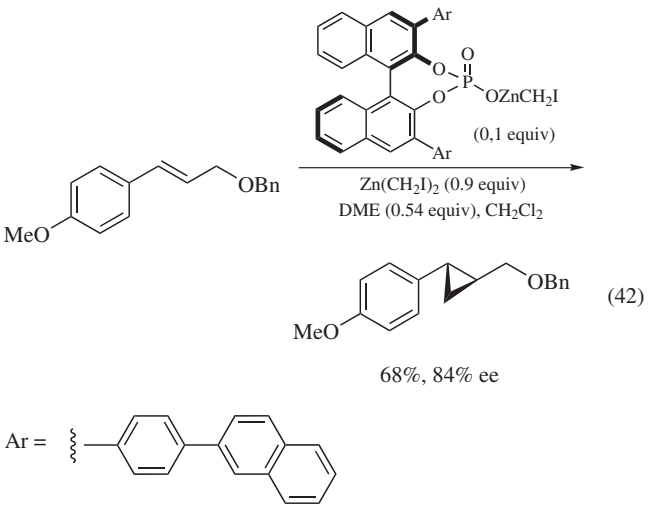
88%, 89% ee

It has also been shown that allylic alcohols could be converted into cyclopropane derivatives in high enantiomeric excesses upon the addition of a titanium-taddolate (eq 41).[62] However, the reaction is limited to (*E*)-aryl or vinyl-substituted allylic alcohols.



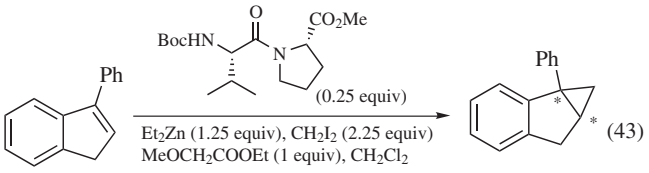

85%, 92% ee (41)

Both chiral reagents described in eqs 38 and 39 have been used in substoichiometric quantities in the presence of stoichiometric $Zn(CH_2I)_2$, as long as Lewis basic additives are included. The cyclopropanation reactions of the chiral phosphate are limited to aryl-substituted silyl- or benzyl-protected allylic and homoallylic alcohols (eq 42),[37] whereas those involving the dipeptide are limited to aryl-substituted alkenes (eq 43).[63]




(42)

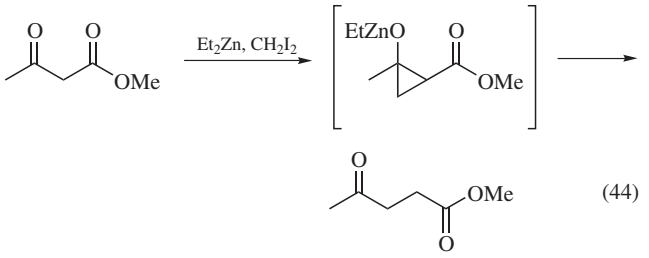
68%, 84% ee




(43)

85%, 77% ee

**Chain Extension of 1,3-Dicarbonyl Derivatives.** Treatment of a 1,3-dicarbonyl derivative with a mixture of diethylzinc and diiodomethane generates a 1,4-dicarbonyl compound through formation of the zinc alkoxide of the corresponding cyclopropanol derivative (eq 44).[64]

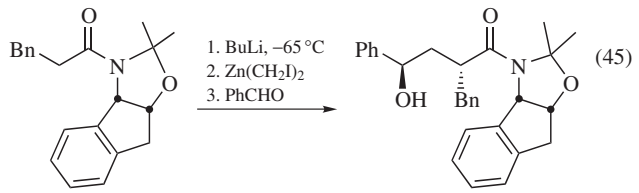



(44)

81%

This reaction has been applied to the chain extension of $\beta$-keto phosphonates,[65] $\beta$-keto amides,[66] and amino acid skeletons.[67]

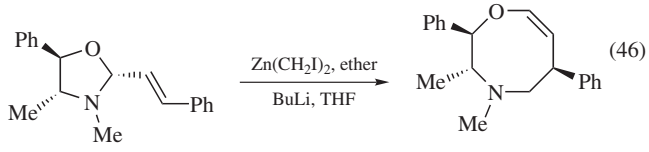
**Homologation Reaction of Organometallic Reagents.** The lithium enolate derived from a protected 1-amino-2-indanol-derived amide can be homologated with bis(iodomethyl)zinc or iodomethylzinc iodide to generate the zinc homoenolate that can be trapped with aldehydes to give $\alpha$-substituted-$\gamma$-hydroxy amides in good yield and excellent stereocontrol (eq 45).[68]




(45)

60%, 80% de

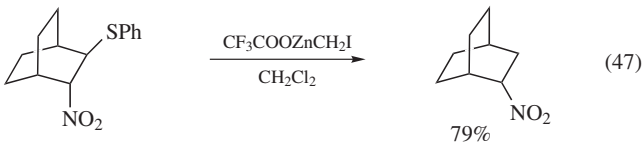
**Ylide Formation.** It is well established that halomethylzinc reagents are good electrophilic agents that can alkylate Lewis basic heteroatoms. This reaction was used to generate a precursor for a [2,3] sigmatropic rearrangement.[69] Treatment of an oxazolidine with bis(iodomethyl)zinc results in the formation of a zinc-complexed methylene ammonium ylide that can undergo a [2,3] sigmatropic rearrangement upon BuLi addition (eq 46).




(46)

72%, >98% dr

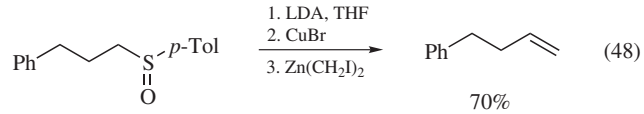
**Alkene Synthesis by Elimination Reactions.** The electrophilicity of iodomethylzinc reagents can be used to trigger alkene formation through elimination reactions. For example, cycloalkanes bearing both an electron-withdrawing group and an arylsulfenyl or arylselenyl group at the $\beta$-position react with Shi's reagent ($CF_3COOZnCH_2I$) to provide the corresponding sulfur or selenium ylide that can eliminate to generate an $\alpha,\beta$-unsaturated system (eq 47).[70]




(47)

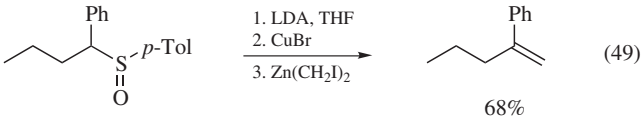
79%

Alternatively, secondary $\alpha$-copper or tertiary $\alpha$-lithiosulfinyl carbanions react with zinc carbenoids to generate an alkene via 1,2-shift/$\beta$-elimination (eqs 48 and 49).[71]




(48)

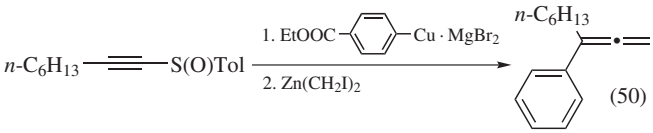
70%




(49)

68%

**Allene Synthesis by Elimination Reactions.** The carbocupration of alkynyl sulfoxides and sulfones followed by an iodomethylzinc iodide-mediated homologation and subsequent $\beta$-elimination leads to allenes (eq 50).[72] The use of a chiral, nonracemic sulfoxide and of a substituted iodoalkylzinc reagent leads to enantiomercially enriched allenes.[73]




(50)

85%

**Related Reagents.** 1,1-Diiodoethane; Diiodomethane.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