

Tungsten Hexachloride (WCl₆) as a Mild and Efficient Reagent for Deprotection of Acetals and Ketals†

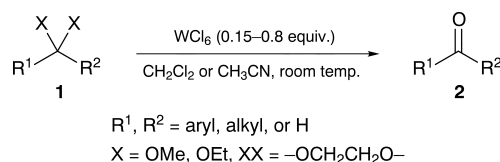
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A variety of acetals and ketals are efficiently and rapidly converted to the corresponding carbonyl compounds by using WCl₆ in dichloromethane or acetonitrile at room temperature.

Acetals are one of the most useful and versatile protecting groups in organic syntheses. They find widespread application for example in the protection of carbonyl, hydroxy, and diol functions.¹ Therefore, regeneration of the parent carbonyl group from their masked form seems to be a useful synthetic process. There are several methods for the deprotection of acetals and ketals such as aqueous acid hydrolysis,¹ and K-10 montmorillonite in aqueous methanol,² and non-aqueous methods including those based on TeCl₄,³ [Ru(CH₃CN)₃(triphos)](OTf)₂,⁴ silica-supported guanidinium chloride–acetyl chloride,⁵ SiCl₄–NaI,⁶ K-10 montmorillonite,⁷ DDQ,⁸ Ph₃P–CBr₄,⁹ SnCl₂·2H₂O,¹⁰ CuSO₄–SiO₂,¹¹ CeCl₃·7H₂O,¹² oxidation methods¹³ etc.¹ But the synthetic application of this transformation is so important that the introduction of improved methods continues to attract attention. New applications of tungsten hexachloride (WCl₆) have been of interest to us in recent years. Halo-dehydroxylation, dihalo-de-bisubstitution reactions and chemoselective dithioacetalization of carbonyl compounds and transthiacetalization of acetals have been reported.¹⁴ In continuation of our studies we have found that tungsten hexachloride efficiently converts various types of acetals and ketals (dimethyl, diethyl and cyclic acetals) to



Scheme 1

the corresponding carbonyl compounds under mild reaction conditions (Scheme 1).

As shown in Table 1 a variety of dimethyl acetals (entry 1) and diethyl acetals (entries 2–6), of structurally different carbonyl compounds as well as 1,3-dioxolanes of aldehydes (entries 7–10) can be cleanly deprotected at room temperature using 0.15–0.2 equivalent of WCl₆ in dry CH₂Cl₂. On the other hand, cleavage of 1,3-dioxolanes derived from aromatic and aliphatic ketones was achieved in dry CH₃CN in the presence of 0.5–0.8 equivalent of WCl₆ (entries 11–16). Nitro and methoxy groups are conserved in this method (entries 5, 8). In conclusion, mild reaction conditions, easy work-up, and excellent yields of the desired products are worthy of mention as advantages of the present method.

Table 1 Deprotection of acetals and ketals with WCl₆

Entry	R ¹	R ²	XX	Subst.:WCl ₆ ratio	Solvent	Time/min	Yield ^a (%)
1	Ph	H	(OMe) ₂	1:0.15	CH ₂ Cl ₂	5	92
2	Ph	H	(OEt) ₂	1:0.15	CH ₂ Cl ₂	5	93
3	<i>p</i> -MeC ₆ H ₄	H	(OEt) ₂	1:0.15	CH ₂ Cl ₂	3	94
4	<i>p</i> -ClC ₆ H ₄	H	(OEt) ₂	1:0.15	CH ₂ Cl ₂	5	91
5	<i>p</i> -NO ₂ C ₆ H ₄	H	(OEt) ₂	1:0.2	CH ₂ Cl ₂	7	98
6	Ph-		(OEt) ₂	1:0.2	CH ₂ Cl ₂	5	98
7	<i>p</i> -MeC ₆ H ₄	H	-OCH ₂ CH ₂ O-	1:0.2	CH ₂ Cl ₂	5	90
8	<i>p</i> -MeOC ₆ H ₄	H	-OCH ₂ CH ₂ O-	1:0.2	CH ₂ Cl ₂	5	89
9	PhCH=CH	H	-OCH ₂ CH ₂ O-	1:0.2	CH ₂ Cl ₂	5	86
10	<i>n</i> -C ₆ H ₁₃	H	-OCH ₂ CH ₂ O-	1:0.25	CH ₂ Cl ₂	15	81
11	Ph	Me	-OCH ₂ CH ₂ O-	1:0.7	CH ₃ CN	10	94
12	<i>p</i> -ClC ₆ H ₄	Me	-OCH ₂ CH ₂ O-	1:0.8	CH ₃ CN	10	89
13	<i>p</i> -PhC ₆ H ₄	Me	-OCH ₂ CH ₂ O-	1:0.8	CH ₃ CN	10	82
14	PhCH ₂ CH ₂	Me	-OCH ₂ CH ₂ O-	1:0.6	CH ₃ CN	10	91
15	Ph-		-OCH ₂ CH ₂ O-	1:0.6	CH ₃ CN	20	75
16			-OCH ₂ CH ₂ O-	1:0.8	CH ₃ CN	15	90

^aThe yields refer to isolated pure products.

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†This is a **Short Paper** as defined in the Instructions for Authors, Section 5.0 [see *J. Chem. Research (S)*, 1998, Issue 1]; there is therefore no corresponding material in *J. Chem. Research (M)*.

Experimental

General Procedure for Deprotection of Acetals with WCl₆.—To a solution of acetal **1** (2 mmol) in dry CH₂Cl₂ or CH₃CN (10 ml), WCl₆ (0.3–1.6 mmol) was added. The solution was stirred at room

temperature, and the progress of the reaction was monitored by TLC. On completion (3–20 min), the reaction was quenched with NaOH aqueous solution (10%; 15 ml), and extracted with CH₂Cl₂ (3 × 30 ml). The organic layer was washed successively with saturated NaCl solution (2 × 15 ml), and water (15 ml) and dried over anhydrous Na₂SO₄. Evaporation of the solvent under reduced pressure gave almost pure product. Further purification was achieved by column chromatography on silica gel or recrystallization from the appropriate solvent to give the desired product in good to excellent yields (Table 1).

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