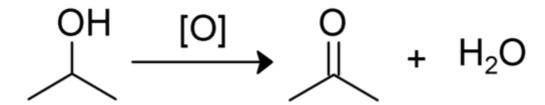
# Oxidation of secondary alcohols to ketones

The **oxidation of secondary alcohols to ketones** is an important oxidation reaction in organic chemistry.



Where a <u>secondary alcohol</u> is oxidised, it is converted to a <u>ketone</u>. The hydrogen from the <u>hydroxyl</u> group is lost along with the hydrogen bonded to the second carbon. The remaining oxygen then forms double bonds with the carbon. This leaves a ketone, as  $R_1$ – $COR_2$ . Ketones cannot normally be oxidised any further because this would involve breaking a C–C bond, which requires too much energy. [1]

The reaction can occur using a variety of oxidants.

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**PCC** (Pyridinium chlorochromate)

**Dess-Martin oxidation** 

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## **Potassium dichromate**

A secondary alcohol can be oxidised into a ketone using acidified <u>potassium dichromate</u> and heating under <u>reflux</u>. The orange-red dichromate ion,  $Cr_2O_7^{2-}$ , is reduced to the green  $Cr^{3+}$  ion. This reaction was once used in an alcohol breath test.

# **PCC (Pyridinium chlorochromate)**

<u>PCC</u>, when used in an organic solvent, can be used to oxidise a secondary alcohol into a ketone. It has the advantage of doing so selectively without the tendency to over-oxidise.

## **Dess-Martin oxidation**

The <u>Dess–Martin periodinane</u> is a mild oxidant for the conversion of alcohols to aldehydes or ketones. [2]

The reaction is performed under standard conditions, at room temperature, most often in <u>dichloromethane</u>. The reaction takes between half an hour and two hours to complete. The product is then separated from the spent periodinane. [3]

## **Swern oxidation**

Swern oxidation oxidises secondary alcohols into ketones using <u>oxalyl chloride</u> and <u>dimethylsulfoxide</u>. It also requires an organic base, such as triethylamine.

The by-products are dimethyl sulfide (Me<sub>2</sub>S), carbon monoxide (CO), carbon dioxide (CO<sub>2</sub>) and – when triethylamine is used as base – triethylammonium chloride ( $C_6H_{15}NHCl$ ). Dimethyl sulfide and carbon monoxide are very toxic and malodorous compounds, so the reaction and the work-up needs to be performed in a fume hood or outdoors.

# Oppenauer oxidation

$$R_1$$
  $R_2$   $R_3$   $R_4$   $R_5$   $R_6$   $R_7$   $R_8$   $R_9$   $R_9$ 

#### Fétizon oxidation

Silver carbonate on celite oxidizes alcohols through single electron oxidation by the silver cations.

# See also

- Oxidation of primary alcohols to carboxylic acids
- Secondary alcohol

## References

- 1. Burton, George et al. (2000). Salters Advanced Chemistry: Chemical (2nd ed.). Heinemann. ISBN 0-435-63120-9
- 2. Dess, D. B.; Martin, J. C. J. Am. Chem. Soc. 1991, 113, 7277-87.

3. J. S. Yadav, et al. "Recyclable 2nd generation ionic liquids as green solvents for the oxidation of alcohols with hypervalent iodine reagents", *Tetrahedron*, **2004**, *60*, 2131–35

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