

Experiment 13:

An aldol condensation

Objectives

The purpose of this experiment is to provide an illustration of how an aldol condensation can be used in organic synthesis. Further practice in obtaining and interpreting infrared spectra is also provided.

Introduction

(Aldol = **aldehyde** + alcohol = β -hydroxy aldehyde)

The aldol condensation (or carbonyl condensation) is a common organic reaction and is of great use to the synthetic chemist because it provides a convenient method of forming a new carbon-carbon bond. In its simplest form, the aldol condensation involves the reaction (via a combination of nucleophilic addition and α -substitution steps) of two molecules of an aldehyde (See Fig. 13.1 below) or ketone. The major requirement of the reaction is that the aldehyde or ketone concerned has at least one hydrogen atom attached to the **α -carbon** atom (in boldface). For example,

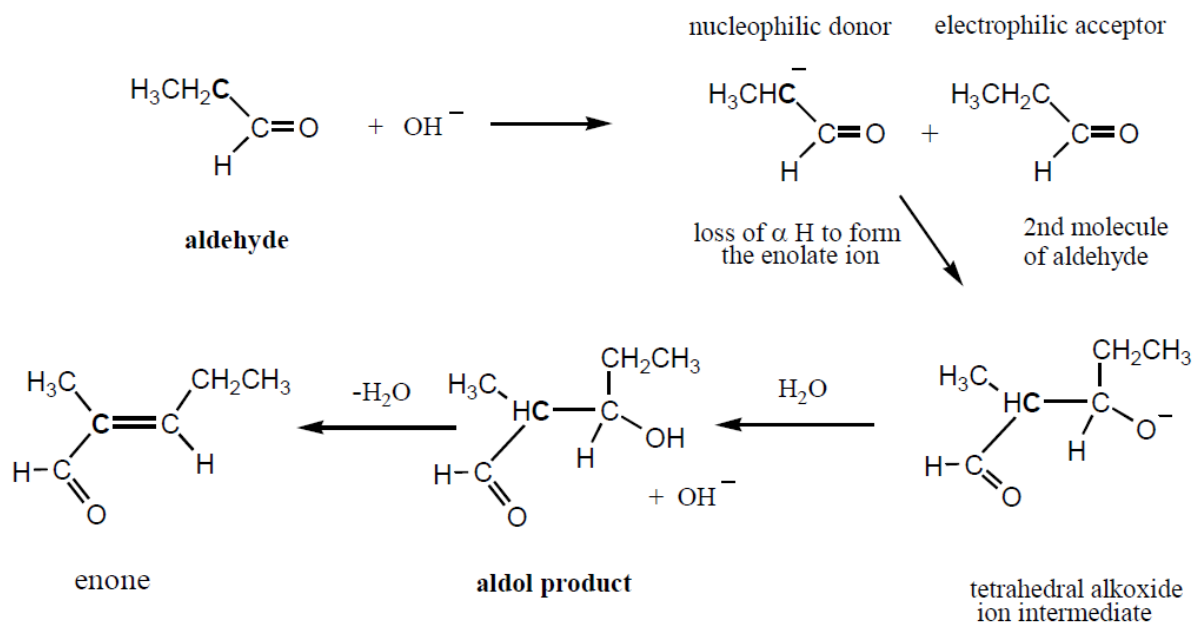


Figure 13.1 Base catalyzed aldol condensation of two aldehyde molecules

Note that the last step shown above results in the formation of a conjugated enone (a dehydrated aldol)

In a mixed (or crossed) aldol condensation, two different carbonyl compounds are used. For instance, in the reaction between acetaldehyde and propanal, this leads to a mixture of four products (2 symmetrical, and 2 mixed aldol products). Not a very useful reaction!

Therefore it is usual to use an aldehyde that has **no** α -hydrogen atoms (e.g., an aromatic aldehyde) and a ketone that is either symmetrical (e.g., acetone, $\text{CH}_3\text{-CO-CH}_3$) or only has α -hydrogens on one side of the carbonyl group (e.g., acetophenone, $\text{C}_6\text{H}_5\text{-CO-CH}_3$). By using such combinations, the number of possible products is kept to a minimum. For example,

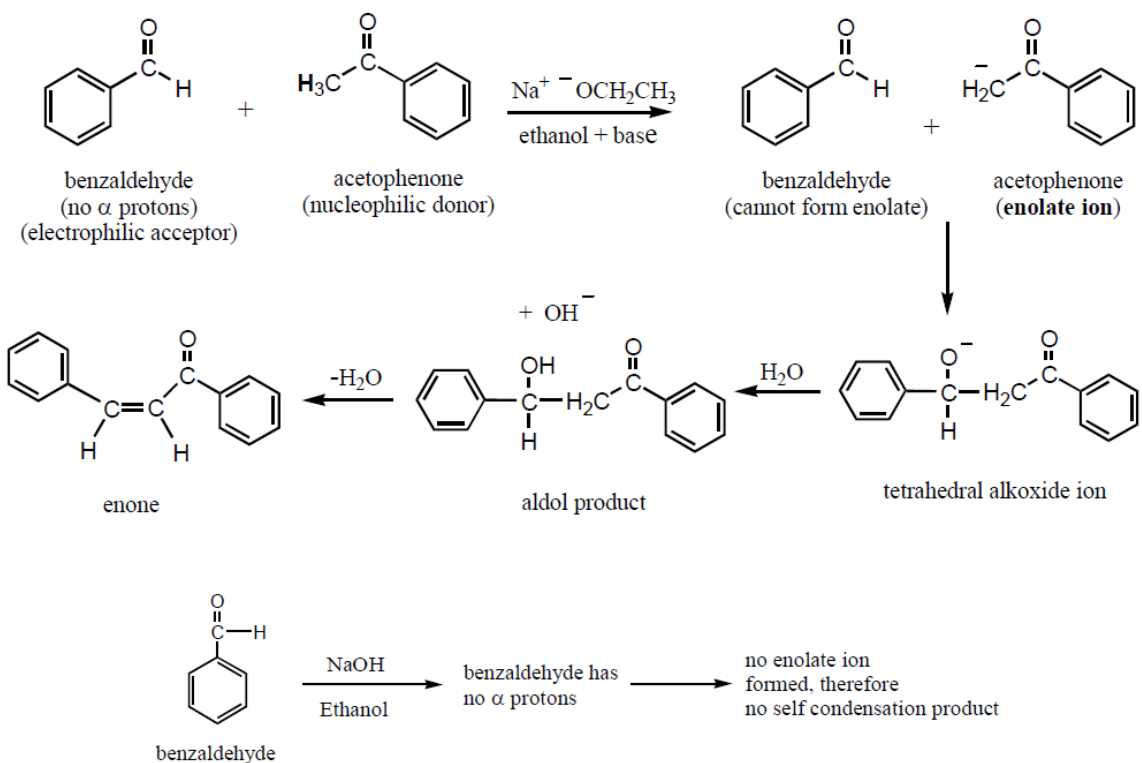


Figure 13.2 Mixed aldol condensation between benzaldehyde and acetophenone.

When a compound such as acetone is used in an aldol condensation (see Fig. 13.3), the presence of two sets of α -hydrogen atoms means that two moles of aldehyde can react with each mole of acetone. It is a reaction of this type that you will perform in this experiment.

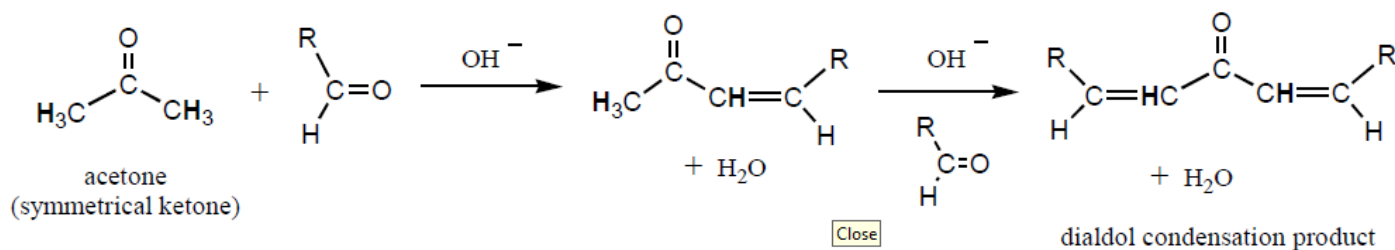


Figure 13.3 Dialdol condensation reaction