Notes on Fischer Esterification

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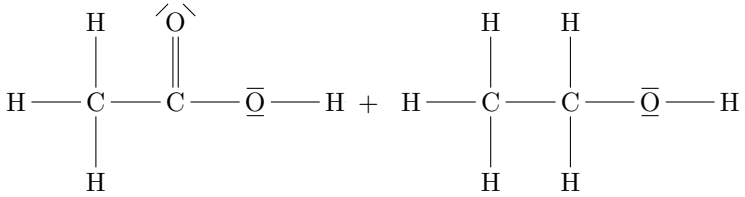
1 Introduction

The overall reaction for Fischer esterification is easy to remember: the proton on a carboxylic acid joins with the hydroxide on an alcohol, and forms water. The leftover is always an ester, because the oxygen in the former carboxylic acid joins the two remaining carbon chains. The mechanism, however, is more complicated. It proceeds in four basic steps:

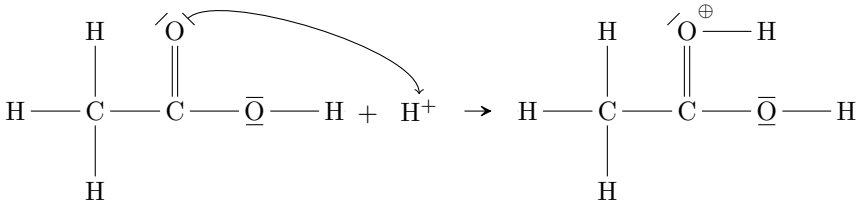
1. A proton is transferred from the acid catalyst to the oxygen in the carboxylic acid.
2. The oxygen atom of the alcohol attacks the carbonyl carbon in the carboxylic acid, joining the two compounds.
3. The hydrogen of the former alcohol group joins with the terminal OH group of the former carboxylic acid, forming water.
4. The water and the hydrogen from the acid catalyst leave.

Each of these steps are shown in detail in the following. I'll use the example from the lecture, starting with ethanoic acid and ethanol (shown below). Keep in mind that any carboxylic acid and any primary alcohol will work.

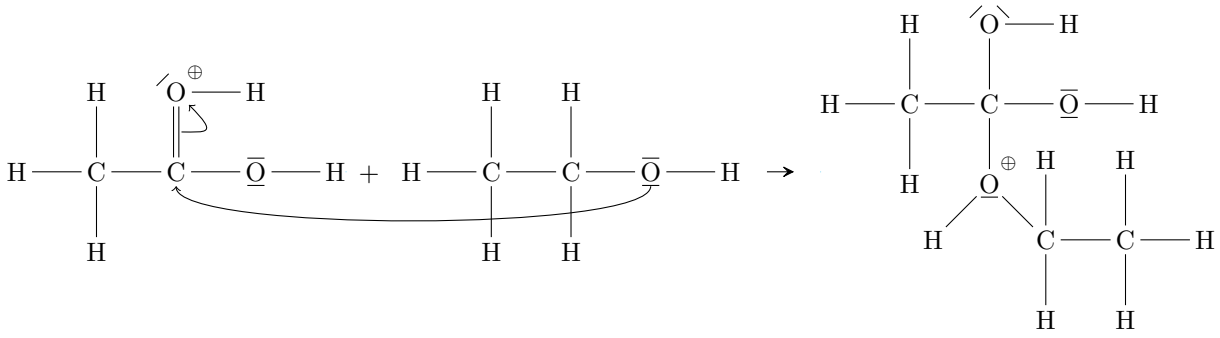


2 Full Mechanism

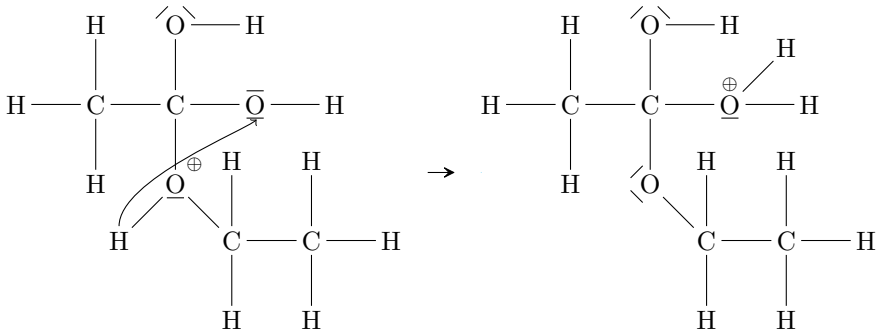
First, the carbonyl oxygen on the carboxylic acid will attack a proton from the acid catalyst:



Next, the oxygen on the alcohol will attack the carbonyl carbon, and the ester bond is formed:



Now, before dehydration, we have to have water. The hydrogen comes from the former alcohol group:



Finally, water and a proton leave. Technically, it involves two attacks: