Crossed aldol condensation is a variation of aldol condensation.

**Aldol Condensation:**

```
<table>
<thead>
<tr>
<th>enolizable aldehyde/ketone</th>
<th>Catalyst: OH^-</th>
<th>α, β-unsaturated aldehyde/ketone</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>H_2O, Δ</td>
<td></td>
</tr>
</tbody>
</table>
```

**Crossed Aldol Condensation:**

```
<table>
<thead>
<tr>
<th>enolizable aldehyde/ketone</th>
<th>non-enolizable aldehyde/ketone containing a sterically unhindered carbonyl carbon</th>
<th>Catalyst: OH^-</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>H_2O, Δ</td>
</tr>
</tbody>
</table>
```

**Example:**

```
CH_3CHO + HCHO → catalyst: NaOH

CH_2=CHCHO
```

**Mechanism**

**Step 1:** The hydroxide ion deprotonates the enolizable aldehyde reversibly.

```
H-C=O   + OH^-   ⇌ CH_2CHO + H_2O
1
```

**Step 2:** Enolate ion 1 preferentially adds to the non-enolizable aldehyde, which has the sterically less hindered and, therefore, more accessible carbonyl carbon.

```
H-C=H   + CH_2CHO   ⇌ H-C=CHCHO + 1
2
```

**Step 3:** Alkoxide ion 2 is protonated by water.

```
H-C=CHCHO + OH^- ⇌ H-C=CHCHO + H_2O
3
```

**Step 4:** Aldol 3 is an enolizable aldehyde. A small amount of it is converted to the corresponding enolate ion 4 by the hydroxide ion.

```
H-C=CHCHO + OH^- ⇌ H-C=CHCHO + H_2O
4
```

**Step 5:** Enolate ion 4 loses a hydroxide ion.
Step 1 through 3 are a crossed aldol reaction, steps 4 and 5 a 1,2-elimination via E1cB mechanism. Thus, crossed aldol condensation is crossed aldol reaction followed by 1,2-elimination.

Contributors

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