**Meyer-Schuster Rearrangement—Convenient Synthesis of α,β-Unsaturated α-Iodinated Aldehydes and Ketones**

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**Abstract** The Meyer-Schuster rearrangement reaction has been known for almost a hundred years. It has been used to prepare unsaturated aldehydes, ketones, and even esters from propargyl alcohols. Thirty years ago, the same reaction was found to produce also α-halogenated aldehydes and ketones under suitable conditions. In the last thirty years, several methods have been developed utilizing the Meyer-Schuster rearrangement in the synthesis of halogenated building blocks for use in synthetic chemistry. In this perspective, we describe the progress in the field.

**Keywords** Meyer-Schuster rearrangement, unsaturated α-iodo enones, propargyl alcohol, Rupe rearrangement

In synthetic chemistry, α,β-unsaturated α-halogenated aldehydes and ketones are useful building blocks for several families of compounds. For example, they are used in the stereoselective vinylogous Mukaiyama aldol reaction,[1] in the synthesis of heterocycles like triazides,[2] and in cross-coupling of iodoenones and stannanes to form bisenones.[3]

One reaction to prepare α,β-unsaturated α-iodo aldehydes and ketones is the Meyer-Schuster rearrangement published first in 1922 by Kurt Heinrich Meyer and Kurt Schuster.[4] In the reaction, a propargyl alcohol undergoes a rearrangement reaction forming an α,β-unsaturated keto-compound. Depending on the position of triple-bond, either an aldehyde or a ketone is formed (Figure 1). Several Meyer-Schuster reactions have been described in two recently published review articles.[5,6]

**Reaction Mechanism**

In the early studies, no reaction mechanism was proposed for the Meyer-Schuster rearrangement leading to α-iodo compounds. In 2007, Chen and Wang[7] proposed the mechanism, which starts from the acid catalyzed elimination and attack by iodide into the positively charged β-carbon leading to the formation of cumulated diene intermediate 1a (Figure 2A). The intermediate 1a is proposed to lead to the loss of the iodine radical through bond cleavage to form an iodo peroxide intermediate 1b that breaks down into radical 1c. Finally, the radical scavenges the iodine radical to form α-iodo aldehyde 2. The radical mechanism was supported by the disturbance of the reaction by the presence of a radical scavenger TEMPO.[7]

Ye and Zhang[8] proposed a mechanism based on the formation of cumulated diene 4 through an intermediate 3a (Figure 2B) by the 3,3-rearrangement.[9] Other interactions between hydroxyl group and catalyst, a metal ion, or a promoter molecule have also been proposed, e.g., oxygen of tosyl-ester[10] oxovanadate,[14] or HOI.[11] Recently, Baire and Sadhukhan postulated a novel mechanism with a cyclic intermediate 4 (Figure 2C).[15]

![Figure 1](image-url)
Stereochimistry of α,β-Double Bond

Both Chen and Wang[9] and Yu et al.[9] described a mixture of E and Z-isomers with asymmetric tertiary alcohols. However, the Z-isomers were predominant in the case of secondary alcohols. Two plausible mechanisms to explain the formation of both isomers have been proposed.[9] The differentiation was assumed to occur because of the attachment either of the gold catalyst or the iodine into the diene. Z-isomer was also shown to be the predominant geometry in the case of alkyl substituted alcohols.[9,10] The stereoselective synthesis of the E-isomer using a vanadium catalyst was published recently.[9]

Conclusions

The Meyer-Schuster reaction has been utilized for the preparation of α,β-unsaturated α-iodinated aldehydes, ketones and esters. Methods have evolved from the early pyridium dichromate oxidation based reaction to sophisticated catalytic methods capable to produce a selective stereoisomer. Even although there are several metal-catalyzed and non-metal catalyzed Meyer-Schuster rearrangements described in the literature, more research is needed. With respect to future perspectives, new methods are needed to prepare complex organic molecules from simple raw materials produced from renewable sources adhering to the principles of the circular economy and sustainability. There is an urgent demand for rearrangement reactions that obey the atom economy by utilizing rearrangements of atoms and groups instead of substitution reactions.

Our group is currently developing new catalytic materials and one approach in which we are interested is the use of the Meyer-Schuster rearrangement. These results will be published soon.

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Conflict of Interest

The authors declare no conflict of interest.

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