

Two Dimensional Technique for the Determination of Stereochemistry in Addition Reaction on C=C

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ABSTRACT

A two dimensional technique has been developed for the determination of configuration of products in addition reaction on C-C double bond. The technique also applied on both *cis* and *trans* alkenes in syn and anti-addition mode.

Keywords : C-C Double Bond, Addition Reaction, 2D Technique, Configuration, Stereochemistry

I. INTRODUCTION

Addition reaction on carbon-carbon double bond is one of the most important types of reaction in basic organic chemistry. In most of the cases, these reactions give highly stereospecific products. As the substrate alkenes are planar (two dimensional) and the products are tetrahedral (three dimensional), thus a three dimensional imagination is necessary to draw the structure of products with stereochemically correct configuration.¹

The structural properties and optical properties (erythro, threo, meso, optically active) are assigned by converting the three dimensional structure to two dimensional Fischer projection formula. Thus the total operation involves 2D→3D→2D interchange. These types of interconversions are time consuming as well as puzzling towards high school as well as early under graduate students. Thus the finding of an easy technique for the direct formation of 2D substrate to 2D product is highly stimulating.

II. METHODS AND DISCUSSION

Stereospecific addition reactions on carbon-carbon double bond can be classified in two categories: (a) syn-addition (such as concerted dihydroxylation,

catalytic hydrogenation, Prevost reaction, Hydroboration-oxidation etc.) and (b) anti-addition (such as halogenations, Woodward modification of Prevost reaction etc.).² The text book procedures for the determination of stereochemistry in addition reaction are shown in figure 1.

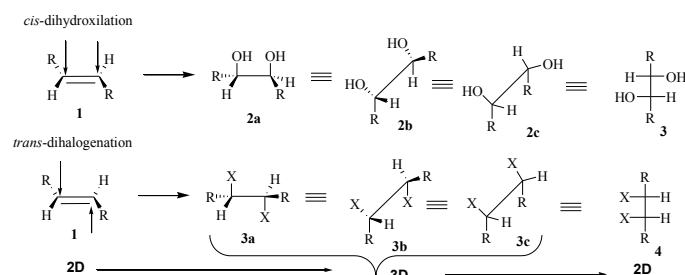


Figure 1: Text book procedure for determination of stereochemistry

To assign the configuration of addition product on carbon-carbon double bond, we have to follow a simple convention. At first the alkene is drawn by keeping the C=C on vertical line and then (a) For *cis*-addition we will follow parallel attack on two sp^2 carbon atom of C=C to form two horizontal bond and (b) for *anti*-addition we will follow the perpendicular attack (one is vertical attack on one carbon and one is horizontal attack on another carbon) on two sp^2 carbon atom of C=C as shown in figure 2.

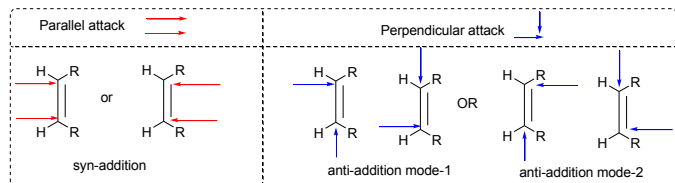


Figure 2: Mode of attack for both syn and anti addition

Let us consider the *syn*-dihydroxylation on both *cis* and *trans*-stilbene. During the formation of two new horizontal bonds, the adjacent two ligands will shift to form two vertical bonds. In case of *syn-addition from left side attack*, the two new C-OH bonds are formed parallel to the horizontal line and the adjacent two H-atoms go to vertical positions (str. **6a**, Fig. 3). After the allowed ligand exchange on **6a**, gives the Fischer projection formula of **6b**. In a similar way, the *syn-addition from right side attack* directly gives the Fischer projection formula **6b**.

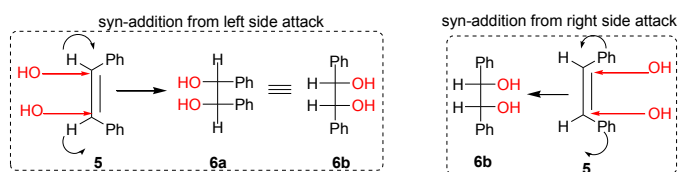


Figure 3 : Syn-dihydroxylation on *cis*-stilbene

Let us consider anti dihalogenation on *cis*-stilbene. In these cases one halogen atom attacks along the horizontal line to one of the two sp^2 carbon of C=C and the other halogen atom attacks on another sp^2 carbon of C=C along the vertical line as shown by blue arrows (**7**, Fig. 4). The structures **8a** or **8c** after the allowed exchange of positions in Fischer projection gives *dl*-pairs (**8b** and **8d**).

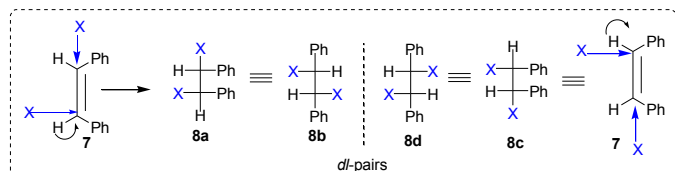


Figure 4: Anti-dihalogenation on *cis*-stilbene

Similarly, the *syn*-addition on *trans*-stilbene gives *dl*-mixtures of 1,2-diphenyl-ethane-1,2-diol as shown in figure 5 and the anti-addition on *trans*-stilbene gives

meso-1,2-dihalo-1,2-diphenyl-ethane as shown in figure 6.

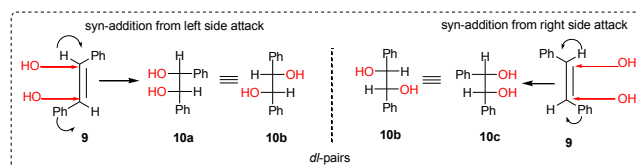


Figure 5: Syn-addition on *trans*-stilbene

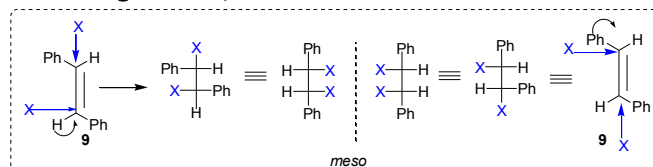
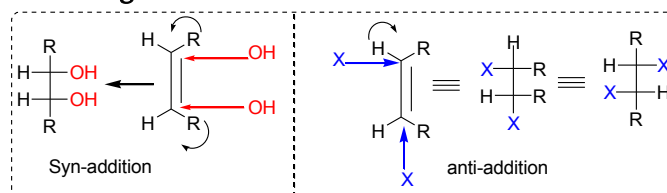


Figure 6: Anti-addition on *trans*-stilbene



III. CONCLUSION

I have developed an easy technique for the determination of configuration of products in addition reaction on C-C double bond without the necessity of three-dimensional imaginations. I hope, this method will be very much helpful for high school and early undergraduate students. In addition, all the students will get little time saving advantages in their competitive examinations.

IV. REFERENCES

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