Carbon-14 Studies on the Mechanism of the Disproportionation of Propene

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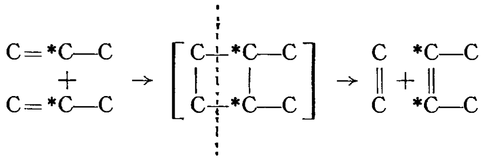
BY experiments with ^{14}C-labelled propene, we obtained information on the mechanism of the disproportionation of propene, a reaction discovered by Banks and Bailey.[1]

$$2C_3H_6 \rightleftharpoons C_2H_4 + MeCH{:}CHMe \quad (\textit{cis} \text{ and } \textit{trans})$$

Experiments were carried out with [2-^{14}C]-propene over a catalyst which is active at moderate temperatures, *viz.* rhenium oxide on alumina. The ethene formed showed no radioactivity at all, in contrast with the butenes, which showed a specific radioactivity twice as much as that of the starting material. The data have been obtained by extrapolation to zero contact times in order to eliminate the influence of isomerisation reactions (accuracy *ca.* ±10%).

These results can only be explained by a reaction mechanism in which a four-membered ring-intermediate is involved, *e.g.*



a similar mechanism has been suggested by Bradshaw *et al.*[2] A linear mechanism, as suggested, *e.g.* by Dowden,[3]

$$2\ C{=}{*}C{-}C \rightarrow [C{-}{*}C{-}C{-}C{-}{*}C{-}C] \rightarrow C{=}{*}C + C{-}C{=}{*}C{-}C$$

is excluded by our experimental results.

Experiments with [1-^{14}C]propene and [3-^{14}C]-propene show that the two methyl groups retain their identity throughout the disproportionation. This excludes an allylic intermediate as has been proved for the oxidation reaction of propene.[4]

Experiments with other alkenes and catalysts are in progress.

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[2] C. P. C. Bradshaw, E. J. Howman and L. Turner, *J. Catalysis*, 1967, **7**, 269.

[3] D. A. Dowden, *Anales real Soc. espan. Fis. Quim.*, 1965, **61**, 326.

[4] W. M. H. Sachtler and N. H. de Boer, *Proc. 3rd. Internat. Congr. Catalysis*, Amsterdam, 1964, **1**, 252 (North Holland Publ. Co., Amsterdam, 1965).