HYDROGENOLYSIS OF C-C BONDS IN ALKANES AND CYCLOALKANES ON METAL COMPLEX CATALYSTS

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Transition metal complexes are capable of activating and cleaving C-H bonds in saturated hydrocarbons [1] while the C-C bonds are not effected.

We have found that the metal complex catalysts obtained by the reaction of transition metal compounds such as carbonyls of molybdenum, rhenium, and rhenium oxide with organoaluminum compounds are capable of activating inert C-C bonds in saturated hydrocarbons and lead to their catalytic hydrogenolysis.

Thus, for example, a system consisting of rhenium carbonyl and triethylaluminum or diisobutylaluminum hydride at 150-180°C catalyzes the hydrogenolysis of C-C bonds in octane, dodecane, cyclopentane, methylcyclopentane, cyclohexane, and cyclododecane. After 15 h at 180°C with 50 atm initial H₂ pressure, the hydrocarbon conversion is 30-80%; one mole of transition metal compound is capable of catalyzing the conversion of hundreds of moles of hydrocarbon. Thus, under these conditions with $\text{Re}_2(\text{CO})_{10}$:AlEt₃:hydrocarbon mole ratio of 1: 10:200, n-octane undergoes 48% hydrogenolysis. The reaction products were (in moles per mole converted octane): n-heptane (0.27%), n-hexane (0.19), n-pentane (0.16) and lower hydrocarbons including 2 moles methane. The major products of the hydrogenolysis of unsubstituted cycloalkanes are linear hydrocarbons with the same number of carbon atoms and the product of the subsequent hydrogenolysis of these linear hydrocarbons.

The starting transition metal compounds in the absence of the organoaluminum compounds as well as rhenium black do not catalyze the hydrogenolysis of saturated hydrocarbons under these conditions.

LITERATURE CITED

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