OXIDATION OF ALKANES BY ATMOSPHERIC OXYGEN IN CH_3CN OR CH_2Cl_2

CATALYZED BY AuCl₄⁻ IONS UPON LIGHT IRRADIATION

G. V. Nizova and G. B. Shul'pin

UDC 541.14:542.943.7:547.592. 12:547.216:547.534.1

Gold complexes [1] are relatively rarely used in catalysis [2]. We have found that the irradiation of solutions of HAuCl₄ (I) in acetonitrile or $(C_4H_9)_4NAuCl_4$ (II) in CH_2Cl_2 in the presence of saturated hydrocarbons in the air leads to the formation of the corresponding alcohols and ketones. The irradiation was carried out using the full light of a 250-W DRL-250(6) luminescent lamp in a cylindrical glass vessel encased in a water-cooling jacket $(\lambda > 310 \text{ nm}, 15^{\circ}\text{C})$ with rapid stirring. The concentration of (I) or (II) was $5 \cdot 10^{-4} \text{ mole}/$ liter and the substrate concentration was 0.46 mole/liter. The photooxidation results are presented below with the product concentrations given in parentheses (x10², mole/liter). The irradiation of cyclohexane in the presence of (I) over 20 h gave cyclohexanol (1.33) and cyclohexanone (1.52). The irradiation of cyclohexane in the presence of (II) over 29 h gave cyclohexanol (1.80), cyclohexanone (1.49), and cyclohexyl chloride (0.05). Ethylbenzene in the presence of (II) over 13 h gives 1-phenylethanol (0.44) and acetophenone (0.96). All these reactions proceed with an induction period. Methanol (0.018) and formaldehyde (0.17)are formed upon the slow bubbling of methane and air through a solution of (I) and irradiation for 10 h. The irradiation of a solution of hexane in CH₂Cl₂ in the presence of $8.3 \cdot 10^{-4}$ mole/liter (II) over 6 h gives 1-hexanol (0.065), 2-hexanol (0.133), 3-hexanol (0.133), hexanal (0.077), 2-hexanone (0.177), and 3-hexanone (0.177). Products of the oxidation of hydrocarbons under the conditions studied were not observed in the absence of gold(III) complexes.

LITERATURE CITED

- 1. R. J. Puddephatt, Topics in Inorganic and General Chemistry, Monograph: The Chemistry of Gold, Elsevier, Amsterdam (1978).
- G. B. Shul'pin, Organic Reactions Catalyzed by Metal Complexes [in Russian], Nauka, Moscow (1988).

N. N. Semenov Institute of Chemical Physics, Academy of Sciences of the USSR, Moscow. Translated from Izvestiya Akademii Nauk SSSR, Seriya Khimicheskaya, No. 10, p. 2393, October, 1989. Original article submitted May 23, 1989.