REACTIONS OF C_4 – C_6 ALKANES ON PLATINUM AND PLATINUM–GOLD FILMS

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Results are reported on the reactions of n-butane, n-pentane and n-hexane on Pt and Pt/Au alloy films. The results are compared with those obtained for Pt–Au alloys on a SiO_2 carrier. It is concluded that alloying can change the selectivity of the catalyst. No indication has been found for the possible role of oxygen in the high selectivity of Pt in non-destructive reactions.

Recently papers have been published /1, 2, 3a/ showing that the selectivity of silica supported Pt catalysts can be varied by alloying Pt with Au. For several reasons it appeared desirable to perform parallel investigations with evaporated alloy films.

Firstly, even such an inert carrier as SiO_2 can have a stabilizing effect on some types of Pt particles (i.e., sites) or Pt compounds (oxides, silicides) which are

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not present on a pure massive metal, Pt black or Pt film. Special sites like those on stepped surfaces or stabilized oxygen compounds /3a, b/ have been suggested in the literature as being responsible for the high selectivity of Pt in the non-destructive reactions of hydrocarbon reforming.

Secondly, whenever an effect of alloying is found with catalysts on a carrier, it should be checked whether this effect is, indeed, a direct consequence of the electronic and geometric structure of the alloys and is not an indirect effect through e. g. particle size, dual function of the catalysts or promotion by accidental contaminations. It can be reasonably expected that the films prepared (evaporated and sintered) under UHV conditions and investigated with small amounts of carefully purified gases are less contaminated (i. e. modified) on their surfaces than alloys on silica. Also, their structure is nearer to that of a massive metal than to that of small particles on a carrier.

All this made the comparison of films and alloys on carriers an attractive subject. The results of a short study limited to several Pt and Pt–Au films are reported below, the alloys were prepared with compositions within the range of full miscibility (0–17% Pt, β-phase).

EXPERIMENTAL

The apparatus used was essentially the same as described in earlier papers /4, 5/. The same holds for the procedure of film preparation and data evaluation. The technique applied consisted in extracting samples via a lock and then injecting into a GLC apparatus for analysis /1, 2/. The number of molecules in the reaction system was approximately the same in all experiments, about 8x10¹⁹ for hydrocarbons and about 1x10²¹ for hydrogen. The reader is referred to earlier papers /2, 5–7/ for information on the phase and surface composition of alloy films and alloys on carriers.

x about 50 Torr hydrogen and 3.8 Torr hydrocarbon with the reaction vessel at 250°C