

The total amount of released oxygen (9.7 mmol from the 1.0 g of active phase) exceeds the probable sorption at each of oxides. This is obviously connected with the dissolving of oxides of superstoichiometric oxygen in formed solid solutions, which are released at lower temperatures [19]. The total amount of released oxygen (mainly due to weak adsorbed oxygen) from the Ni-Cu-Cr catalyst depends on the conditions of preparation of mixed carbonates and their decomposition. It is increased by 2 times when using $\text{NH}_4\text{HCO}_3 + \text{Al}(\text{NO}_3)_3$ in the precipitation of mixture.

Calculation of activation energy release of oxygen from the catalyst showed that it is 88 - 89 kJ/mol. Desorption energy from single copper oxides is 128 kJ/mol; from nickel oxides - 120 kJ/mol and from mixed oxides - 140 - 144 kJ/mol.

Heating of Ni-Cu-Cr/2% Ce/ θ - Al_2O_3 catalyst at 1,473 K sharply reduces the release of oxygen in the area of decomposition of metal oxides for the initial and promoted contacts (Figure 2). The area of adsorbed oxygen completely disappears in the spectrum of Ni-Cu-Cr and Ni-Cu-Cr + Pt catalysts. The observed phenomenon can be explained by the fact that most of the metal oxides reacts with the carrier to form large (200 – 1,000 Å) Ni(Cu) Al_2O_4 aluminates (XRD and TEM), because of which the total surface area of contacts is reduced from 60 to 5 m² g⁻¹ [20].

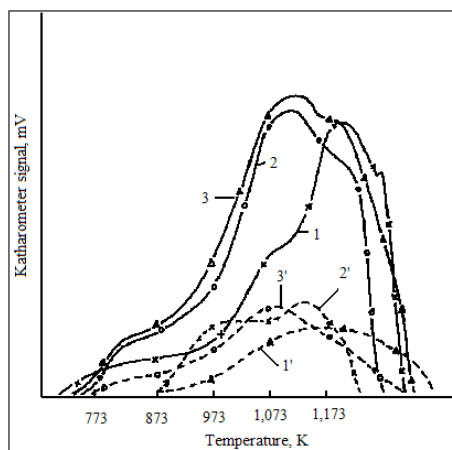


Figure 2 – Thermal desorption of oxygen from the Ni-Cu-Cr/2 % Ce/ Al_2O_3 catalyst heated in oxygen and promoted with Pd and Pt: 1 - Ni-Cu-Cr/2 % Ce/ Al_2O_3 , 2 - Ni-Cu-Cr/2 % Ce/ Al_2O_3 + Pd, 3 - Ni-Cu-Cr/2 % Ce/ Al_2O_3 + Pt. 1¹, 2¹, 3¹ - catalysts after heating at 1,473 K, T – 873 K

The study of temperature-programmed reduction of Ni-Cu-Cr/2% Ce/ θ - Al_2O_3 catalysts allowed to make one more step in understanding of reduction mechanism and elimination of oxygen from oxides, and to assess the ability of catalyst to absorb oxygen from gas phase.

Figure 3a shows that the TPR curve has four hydrogen absorption peaks: $T_1 = 523$ K, $T_2 = 573$ K, $T_3 = 673$ K and $T_4 = 1,073$ K corresponding to reduction of CuO (T_1), mixed oxides CuO-NiO (T_2), NiO (T_3) and formed partially Ni or Cu aluminates.

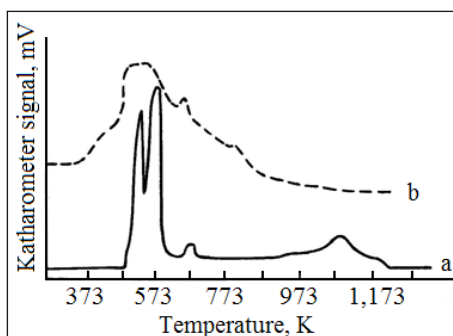


Figure 3 – TPR and TPO spectra of the initial Ni-Cu-Cr/Ce/ θ - Al_2O_3 catalyst: a - TPR of the initial catalyst, b - TPO after TPR up to 1,225 K