

TPD and IRRAS Investigation of CO Adsorption on Cu(211) and Pt/Cu(211) Surfaces

A. Mohammadpour^{1,2}, S. Kaya^{1,2,*}

¹ Department of Chemistry, Koç University, 34450 Istanbul, Türkiye, Koç University Tüpraş Energy Center (KUTEM), 34450 Istanbul, Türkiye.

² Koç University Tüpraş Energy Center (KUTEM), 34450 Istanbul, Türkiye.

*sarpkaya@ku.edu.tr

Platinum, highly active but expensive metal, can be used as a thin layer on a cheaper metal like Cu, and its activity can be modified by the thickness dependent structural effects. Another important aspect is low coordination sites such as steps on the surface. In this study, Pt deposited on Cu(211) single crystal as a model for stepped surfaces at 300 K. Cu(211) consists of (111) terraces three atomic rows wide and separated by steps of monoatomic height. The interaction of carbon monoxide with Cu(211) and Pt/Cu(211) surfaces was investigated by a combination of infrared reflection absorption spectroscopy (IRRAS) and temperature-programmed desorption (TPD) experiments in ultra-high vacuum (UHV). TPD results showed two main CO desorption peaks in TPD profiles with a high-temperature TPD peak (~ 200 K) corresponding to the CO adsorption on the step on-top sites, and the lower temperature TPD peak (~ 150 K) corresponds to the adsorption on the sites on terraces. TPD and IRRAS measurements on Cu(211) suggested that at low CO coverage, the main adsorption site is the step sites. The deposition of Pt on Cu(211) surface showed that the binding energies of CO on the Pt/Cu(211) surface depend on the Pt coverage. Furthermore, we observed a reduction in the CO desorption temperature from Pt on top sites compared to Pt(111) and Pt(211) surfaces. The desorption of CO from step sites shifts to higher temperatures with increasing the Pt amount. Also, at low CO coverage, CO tends to adsorb on Pt atoms first. We observed a blueshift in CO stretching frequencies from 2028 cm^{-1} to 2059 cm^{-1} , and the CO desorption peak increased from ~ 352 to 370 K (Fig 1). The observed changes, which could be attributed to increased binding energies and alterations in coordination of Pt and Cu atoms, can be explained by considering the ligands and/or structural effects.

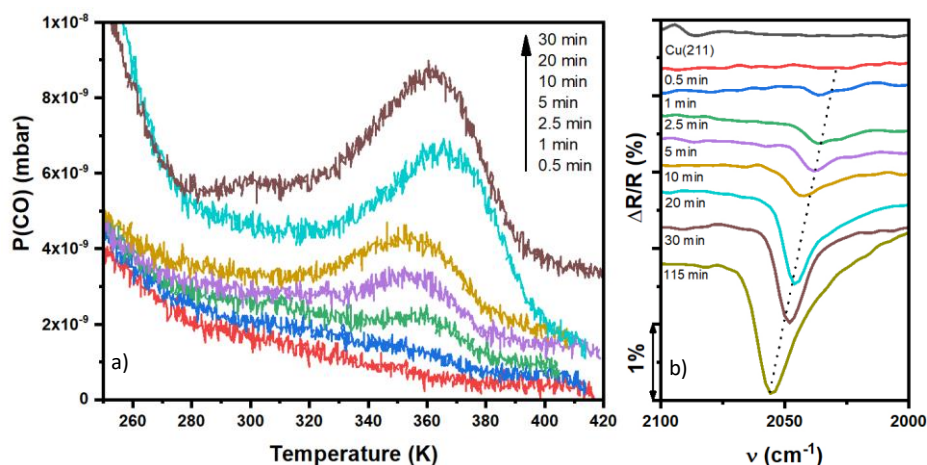


Fig. 1. TPD results after exposing Pt/Cu(211) with different Pt deposition time to 1 L CO at 100 K. (b) CO adsorption peak in IRRAS after saturation surface with CO at 100 K and increasing temperature to 300 K.