Kinetic limitations in surface alloy formation: PtCu/Ru(0001)

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Abstract:
We have systematically investigated the structure and structure formation of two-dimensional PtCu monolayer surface alloys on Ru(0001) as model systems for bimetallic PtCu catalysts and surfaces by scanning tunneling microscopy (STM). The surface alloys were prepared by deposition of Pt and Cu on Ru(0001) and thermal intermixing; different procedures were developed and tested to produce bimetallic surfaces with homogeneous structure, including also a homogeneous distribution of the different surface species, while at the same time intermixing with the Ru(0001) substrate should be inhibited. STM imaging revealed that for Pt concentrations below 65% surface alloys with homogeneous distribution could be formed, while at higher concentrations in the mixed phase, up to 82%, pure Pt or Pt-rich surface areas were formed as well. At Pt contents $0.20 < x_{\text{Pt}} < 0.65$, the Pt$_{x}$Cu$_{1-x}$/Ru(0001) surface alloys were pseudomorphic, while lower Pt contents resulted in triangular dislocation line patterns. Also at $x_{\text{Pt}} > 0.65$ line structures were observed, but of different nature. The distribution of surface atoms in the mixed phase was evaluated from STM images with chemical contrast, the related short-range order parameters were determined. The resulting structures and their energetics, the influence of different deposition and annealing procedures and the suitability of these surfaces as model systems for studies of the surface chemistry of bimetallic PtCu surfaces are discussed.

Keywords: Bimetallic surface, Surface alloy formation, Short-range order, Platinum, Copper, Scanning tunneling microscopy

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