

Abstract

The structure and reactivity of the oxygen phases on Ru(0001) and Ru(10 $\bar{1}$ 0) and the bulk RuO₂(101) surface were studied by quantitative LEED I/E analysis, TDS and AES. On Ru(0001), the (2×2)-3O phase forms at an O coverage of 0.75 ML. The atomic structure of this phase turned out to be a (2×2) vacancy structure of a (1×1)-O network on Ru(0001). CO does not adsorb on the (2×2)-3O overlayer in sample temperature range of 100 K and 300 K. At O coverages above 2–3 ML, RuO₂ grows on Ru single crystals. Under UHV conditions, RuO₂(110) is formed on Ru(0001), while on Ru(10 $\bar{1}$ 0), the (100) face of RuO₂ is exposed. CO molecules bind selectively and strongly on cus (coordinatively unsaturated sites) Ru atoms of these RuO₂/Ru surfaces. The CO molecules on the RuO₂(110) and RuO₂(100) surfaces can readily recombine with the lattice O atoms to produce CO₂. The oxide formation is responsible for the high activity of the O-rich phases of Ru(0001) for the CO oxidation. In addition, the weakly bound O species on the RuO₂(110) surface was characterized, which may provide a more efficient reaction pathway of the CO oxidation at 350 K, and stabilize the RuO₂ catalyst in that the CO-induced vacancies are healed. The bulk RuO₂(101) crystal reveals an equally high activity for the CO oxidation reactions as the RuO₂(110) and RuO₂(100) surfaces.