3E08

RuCu 合金ナノ粒子の合成と物性

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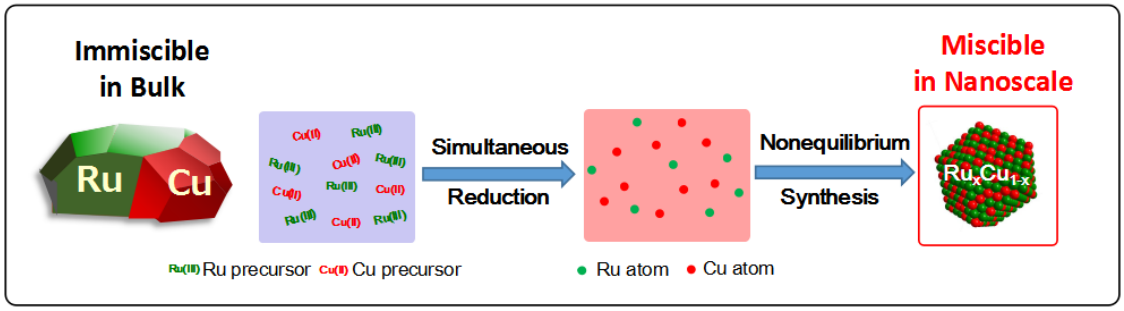
Keywords: Ruthenium; Copper; Nanoparticles; Alloy; Polyol Process Synthesis



More attention has been paid to improving materials properties by means of alloying elements. In particular, the solid-solution type alloy has the advantage of being able to control the properties continuously by changing compositions and/or combinations of constituent elements. However, the majority of the bulk alloys are of the phase-separated type at ambient conditions, where constituent elements are immiscible with each other.

Ruthenium is major catalyst in many important industrial applications. On the other hand, copper is one of the cheapest metals with good catalytic performance. In the Ru-Cu bulk system,[1] these elements are immiscible, even in the liquid phase above 2400 °C; rather, the alloys form a segregated

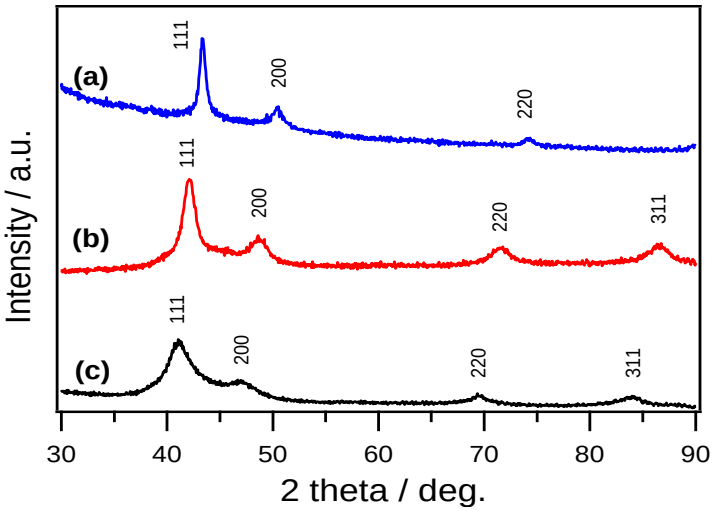


Fig.1. XRPD patterns of **(a)** Cu NPs, **(b)** RuCu NPs and **(c)** fcc Ru NPs.

domain structure. Therefore, RuCu solid-solution alloys have not been obtained so far.

Here, we first report on atomically mixed alloy nanoparticles (NPs) composed of Ru and Cu by means of polyol process. The RuCu alloy NPs were synthesized by a simultaneous reduction of Ru and Cu precursors in the presence of poly(N-vinyl-2-pyrrolidone). Diethylene glycol (DEG) was used as a solvent and a reducing agent. The mixture solution of the metal precursors was added into DEG solvent by syringe technique under inert condition. The reaction was performed under 230 °C for 10 min. The obtained RuCu NPs have been characterized by an X-ray powder diffraction (XRPD) and transmission electron microscope (TEM). From the XRPD pattern, RuCu NPs formed a face-centered cubic (fcc) structure as well as Ru and Cu monometallic nanoparticles. The diffraction peak positions of the RuCu NP were located between those of Ru and Cu NPs, suggesting the formation of atomic-level RuCu alloy. From scanning TEM image, the mean diameter of the RuCu NPs was estimated to be 7.8 ± 2.1 nm, and the overlay of energy dispersive spectroscopy (EDS) mappings demonstrated that Ru and Cu atoms are distributed over the whole particle.

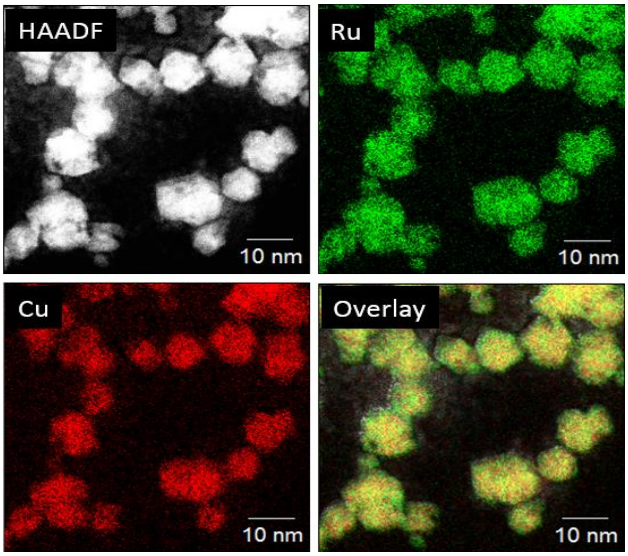


Fig.2. HAADF image and STEM-EDS mappings of RuCu NPs.

Reference

1. T.B. Massalski et al, Binary Alloy Phase Diagrams. Vol. I and II, ed. American Society of Metals,1986.