

Phase-Controlled Metal NPs for Catalytic Applications

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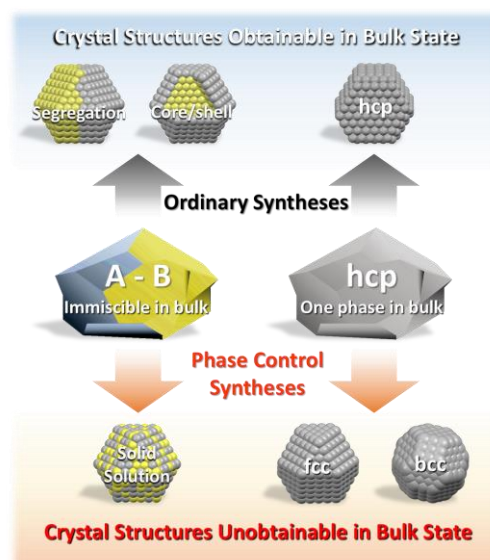
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Kohei Kusada received his Ph. D. in 2013 at Kyoto University under the supervision of Prof. Hiroshi Kitagawa. He worked as a JSPS research fellow (DC1) from 2010 to 2013. After a period at Asahi Kasei Chemicals Co. as a researcher (2013 - 2014), he moved back to Kyoto University as an assistant professor in Prof. Kitagawa's group. He is a Community Board member of *Nanoscale Horizons* (RSC). He received the Springer Theses Award (2014) and the Inoue Research Award for Young Scientists (2014) for his thesis.

Abstract: There is unrevealed potential for nanomaterials whose crystal structures are unobtainable in the bulk state. Properties of metals such as catalytic properties are influenced by their electronic structure and surface structure. If we could control the crystal structure of materials regardless of elemental species, we would be able to discover a new aspect of elements. Therefore, to exploit the full potential of the elements, it is considered that nanoparticles having a novel phase become candidates for new functional materials. We have successfully synthesized phase-controlled nanomaterials with simple chemical reduction methods. [1] As the examples of phase-controlled materials, we have created solid-solution alloy NPs such as AgRh, PdRu and AuIr, and controlled fcc or hcp crystal structure of Ru and AuRu solid-solution alloy NPs. [2-6] In the bulk state, these alloy systems are immiscible even above the melting points, also Au or Ru adopts only fcc or hcp phase. These materials show unique catalytic properties compared with conventional materials. For example, since Rh is located between Ru and Pd in the periodic table of elements, Pd_{0.5}Ru_{0.5} solid-solution alloy has a similar electronic state to Rh and exhibits superior NO_x reduction catalytic activity to Rh. Furthermore, we succeeded in selectively synthesizing fcc and hcp AuRu NPs and these alloys showed a different catalytic property for oxygen evolution reaction. The details of syntheses and catalytic properties will be discussed.



References: (1) K. Kusada, H. Kitagawa, *Adv. Mater.*, 28, (2016) 1129-1142. (2) K. Kusada, et al., *J. Am. Chem. Soc.*, 132, (2010) 15896-15898. (3) K. Kusada, et al., *J. Am. Chem. Soc.*, 135, (2013) 5493-5496. (4) K. Kusada, et al., *J. Am. Chem. Soc.*, 136, (2014) 1864-1871. (5) Q. Zhang et al., *Nat. Commun.*, 9, (2018) 510. (6) K. Kusada, et al., *Chem. Sci.* 10, (2019) 652-656.