Liquid Metal-Transition Metal High-Entropy Alloy Nanoparticles and Their Catalytic Properties

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High-entropy alloy (HEA) is defined as solid-solution alloy composed of more than 5 elements, which greatly enriches the diversity of materials library because of the vast compositional and configurational space for more than 15 years.[1] Not like the bulk, the development of very small HEA nanoparticles (NPs) is still in its dawn stage, mainly due to the difficulties in the synthesis. [2]

Here, we first report the synthesis of HEA NPs consisting of liquid metals (LMs: Sn, In, Ga, etc.) and transition metals (TMs: platinum-group metals (PGMs), etc.) (denoted as LM-TM HEA NPs), using a facile wet-chemistry method. TMs and LMs have their unique properties, and therefore LM-TM alloy NPs are expected to possess novel and/or enhanced properties. However, there are few reports even in the binary system so far. The successful preparation of LM-TM HEA NPs was confirmed by revealing their crystal structure and electronic structure with a series of X-ray based spectroscopies and electron microscopy (**Figure A**, In-PGM HEA NPs as an example). The as-prepared LM-TM HEA NPs showed distinct catalytic properties from the corresponding monometallic NPs in CO_2 hydrogenation reaction.

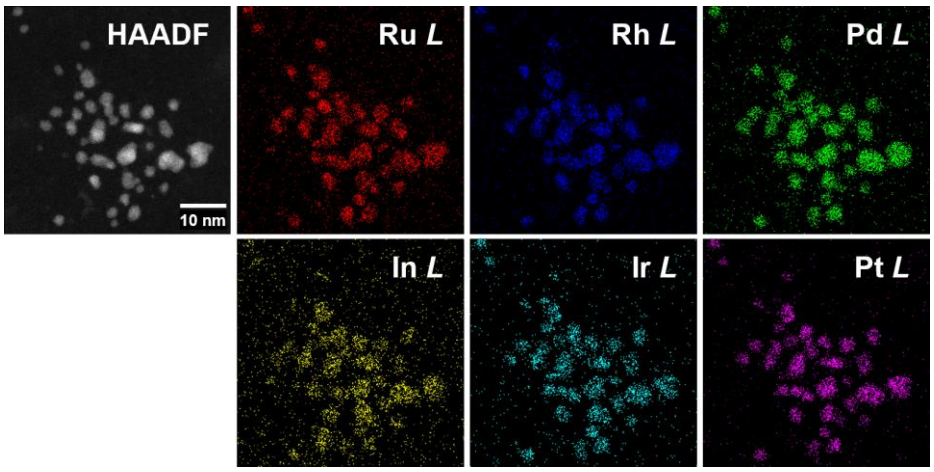

Figure A. HAADF-STEM image of the In-PGM HEA NPs and the corresponding EDX maps using the *L*-line characteristic X-ray from each element.

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