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CARES Visiting Scientist Seminar Series:

Design of Multimetallic Alloys Based on Intermetallics for Highly Efficient Catalysis: Ternary to High-Entropy

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C4T Cambridge Centre for Carbon Reduction in Chemical Technology

Abstract: Multimetallic alloys have increasingly attracted attention as efficient catalyst materials due to their greater activity, selectivity, and stability than conventional binary alloys. However, since there are numerous requirements for improved catalytic functions for future innovations, a more sophisticated concept of catalyst design having high flexiblity, tunability, and expandability is necessary to construct a truly functional active environment. We have developed a series of ternary alloy catalysts based on binary intermetallics A*m*Bn, in which a part of A site is substituted with a third metal A', namely pseudo-binary alloys: (A1−*x*A'*x*)*m*Bn. Owing to the ordered structure of the parent intermetallic phase and the wide composition width of *x*, a pseudo-binary alloy has high probability of close contact of all the constituent elements and high tunability of catalytic properties. Moreover, further multimetallization of A and B sites is possible, forming a high-entropy intermetallic (HEI) structure, (A1−*x*−*y*A'*x*A''*y*)*m*(B1−*p*−*q*B'*p*B''*q*)n. Not only the advantages seen in the ternary system, HEI can easily isolate the active metal for "site-isolation" and has greater thermal stability originating from mixing entropy. We introduce the recent development of highly functional catalysts for the oxidative dehydrogenation of propane using CO_2 (CO_2-ODP) as an example. (CO_2-ODP) is a promising technique for high-yield propylene production and CO_2 utilization. The development of a highly efficient catalyst for CO_2-ODP is of great interest and benefit to the industry and net zero emissions. Here, we report unique catalyst materials and design concepts based on pseudo-binary alloys and HEI for this challenging chemistry.

About the speaker: Prof Shinya Furukawa is a Full Professor in the Division of Applied Chemistry, Graduate School of Engineering, at Osaka University. He specialises in heterogeneous catalysis using advanced multimetallics such as high-entropy intermetallics. He has authored/co-authored 100+ articles in high-impact journals where his catalyst design concept, which is highly flexible, expandable, and multifunctional, achieved drastic improvements in catalytic performance in highly demanded molecular conversions such as hydrocarbons refinery, CO2 utilisation, and hydrogen production.

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