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Revealing Intricacies of Nano-Sized Intermetallic GaPd2 Catalysts

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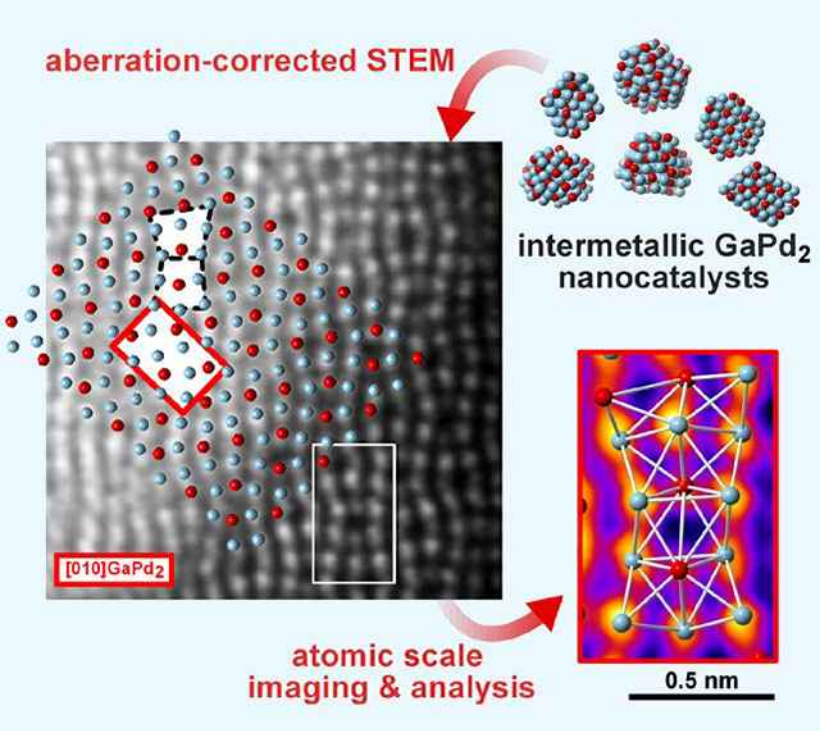
The use of intermetallic compounds in catalysis is a promising means of achieving well-defined catalytic active sites with high selectivity. Simultaneously, it is desirable to nanostructure the catalyst to maximize activity. However in nanoparticulate form, structures and properties quite distinct from bulk systems may arise. Thorough characterization of the nano-sized catalyst is therefore required, for which the high-resolution analysis provided by transmission electron microscopy (TEM) can be invaluable. The directly interpretable imaging provided by aberration-corrected annular dark-field scanning TEM especially, can reveal atomic-scale intricacies and intrapopulation heterogeneities with clarity. Recently, a promising new class of selective hydrogenation catalyst has emerged based on intermetallic Ga-Pd compounds [1]. In foundational studies, use of bulk or powdered model systems led to insights into the relationship between structural and electronic properties and catalytic performance. Aiming for industrial applicability, attention is now being given to high-performance nanoparticulate Ga-Pd catalysts. Through high-resolution imaging, spectroscopic and 3D tomographic TEM studies, significant insight into the crystallographic status of unsupported Ga-Pd nanocatalysts, GaPd2 in particular, has been possible [2,3]. Further to direct verification of the distinctive intermetallic structure in nano-sized particles, catalytically significant and crystallographically intriguing deviations compared to the 'ideal' bulk crystal are revealed. These include strong surface segregation, lattice relaxation and particularly interesting morphologies of the small (<10 nm) particles that comprise both nanocrystalline 'fcc-like' and 'non-crystallographic' five-fold twinned structures. The extent to which the intermetallic structure may be maintained in nanoscale morphologies and the nature of the resultant catalytically active sites are important aspects to be addressed.

[1] *M. Armbrüster et al, J Am Chem Soc, 2010, 132, 14745-14747,* ***[2]*** *R. Leary et al, ChemCatChem, 2013, 5, 2599-2609,* ***[3]*** *R. Leary et al, J Phys Chem C, 2012, 116, 13343-13352*



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