The effect of particle proximity on the oxygen reduction rate of size-selected platinum clusters

Abstract:
The diminished surface-area-normalized catalytic activity of highly dispersed Pt nanoparticles compared with bulk Pt is particularly intricate, and not yet understood. Here we report on the oxygen reduction reaction (ORR) activity of well-defined, size-selected Pt nanoclusters; a unique approach that allows precise control of both the cluster size and coverage, independently. Our investigations reveal that size-selected Pt nanoclusters can reach extraordinarily high ORR activities, especially in terms of mass-normalized activity, if deposited at high coverage on a glassy carbon substrate. It is observed that the Pt cluster coverage, and hence the interparticle distance, decisively influence the observed catalytic activity and that closely packed assemblies of Pt clusters approach the surface activity of bulk Pt. Our results open up new strategies for the design of catalyst materials that circumvent the detrimental dispersion effect, and may eventually allow the full electrocatalytic potential of Pt nanoclusters to be realized.

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