

Boudart M, Aldag A W, Benson J E, Dougharty N A & Harkins C G.

On the specific activity of platinum catalysts.

J. Catal. 6:92-9, 1966.

The rate of catalytic hydrogenation of cyclopropane was studied over platinum. Rate per unit surface area of metal was found to be almost independent of dispersion, defined as the fraction of platinum atoms exposed at the surface. The reaction was said to belong to a class of 'facile' reactions. Reactions not conforming to this pattern were called 'demanding'. [The SCI® indicates that this paper has been cited over 150 times since 1966.]

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"When I moved from Princeton in 1961, a pleasant surprise awaited me in Berkeley. Neil Dougharty, a Princeton graduate student, had also moved to work with me. I gave him a difficult Ph.D. problem: to prepare platinum catalysts with widely different particle sizes from 10 Å upward, to measure the surface area of the metal and the rate of a catalytic reaction per unit surface area of platinum. Neil went to work and finished his dissertation in just three years. The results were so surprising that I decided the work should be repeated and extended at Stanford where I moved in 1964 with Neil's equipment. Jack Benson, an old friend from Princeton days, took a sabbatical year and perfected the method of measurement of platinum surface area, which we published in 1965.¹ This paper has also become a Citation Classic. Girvin Harkins, a postdoctoral assistant, repeated

Neil's work. Art Aldag, a new graduate student, helped in several ways. By the end of 1965, all the evidence was in and it was still startling.

"The conclusion was that the rate of hydrogenation of cyclopropane to propane per unit surface area of platinum decreased by a factor of two when the metal particles varied from 10 Å to 1000 Å. The reason why this finding had attracted considerable attention was my recognition that what mattered was not the twofold change but the fact that the change was trivially small. I concluded that the reaction was what I christened a 'facile' one, but I recognized the possibility that other reactions would not be facile. I called them 'demanding.' Several have been discovered since. I wrote up the work and traveled to Houston, Texas, where Girvin Harkins and Neil Dougharty were doing postdoctoral work. After a stormy discussion, we agreed on the facts and their interpretation. The paper was sent in shortly after that.

"It is a tribute to the experimental skill of all my collaborators in this work that it was reproduced more than ten years later at Northwestern University.² The new results obtained on different catalysts agree with the old ones. This is still rare in heterogeneous catalysis. Moreover, excellent agreement with the new and old work has also been reported by researchers at Berkeley who used single crystals of platinum as catalysts.³

"In retrospect, we were fully entitled in our 1966 paper to express our amazement at finding what has come to be known as the 'structure insensitivity' of a catalytic reaction on a given metal. It seems that we succeeded in communicating our sense of wonderment to others who have read, quoted, and repeated our work over the years."

REFERENCES

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