Probing the Oxidative Etching Induced Dissolution of Palladium Nanocrystals in Solution by Liquid Cell Transmission Electron Microscopy

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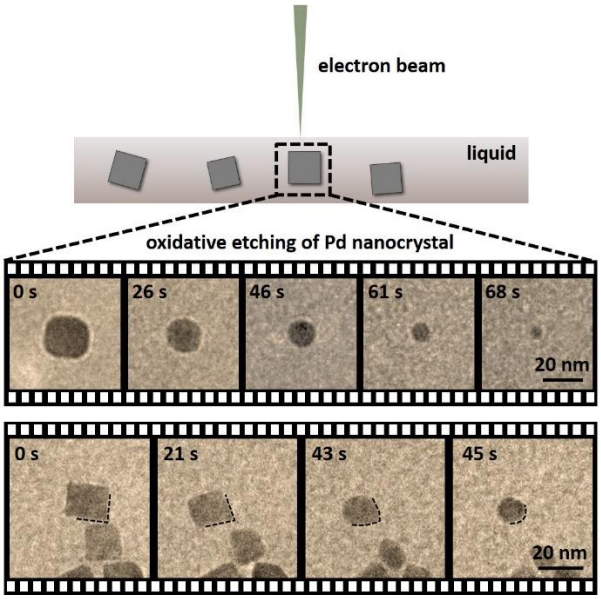
A microscopic study of dissolution process of nanocrystals, an opposite while functioning cooperatively with growth in many cases, is an essential issues in variety aspects of research on nanocrystals. In this work, an *in situ* study of the dynamic dissolution process of palladium nanocrystals by liquid cell transmission electron microscope (TEM) is presented. The effective critical size ($R_{critical}$) for monodispersed nanocrystals is determined to be about 5 nm in the experimental condition of this article. When the size of nanocrystal is above $R_{critical}$, the dissolution rate (dr/dt) is nearly a constant. For the nanocrystal sizing below $R_{critical}$, the dissolution rate (dr/dt) increases with the decrease of the nanocrystal radius r, indicating that high equilibrium solubility must be taken into account in the dissolution rate of small nanocrystals in solution. It is found that the aggregation kinetics and confinement effect between adjacent nanocrystals have effects on the dissolution rate during the reaction, and it has been analyzed in details and discussed in terms of the underlying physics involved. Lastly, the effects of electron beam-water interaction and the iron (III) agents on the oxidative etching are also compared.



Reference:

1. Jiang Y, Zhu G, Dong G, et al. Micron, 2017, 97: 22-28.

2. Jiang Y, Zhu G, Lin F, et al. Nano letters, 2014, 14(7): 3761-3765.

We acknowledge financial support by the National Basic Research Program of China (Grant No. 2014CB932500 and No. 2015CB921004), the National Science Foundation of China (Grant No. 51472215, No. 51222202, No. 61571197 and No. 61172011).