Symmetry Making and Breaking in Seeded Syntheses of Metal Nanocrystals

Sara E. Skrabalak[1]*

[1]Chemistry Department, Indiana University – Bloomington, 800 E. Kirkwood Ave. Bloomington, IN, 47405, United States of America

email: sskrabal@indiana.edu

Abstract

Crystal growth theory predicts that heterogeneous nucleation will occur preferentially at defect sites, such as the vertices rather than the faces of shape-controlled seeds. Platonic metal solids are generally assumed to have vertices with nearly identical chemical potentials, and also nearly identical faces, leading to the useful generality that heterogeneous nucleation preserves the symmetry of the original seeds in the final product. This presentation will discuss how this generality can be used to access stellated metal nanocrystals with high and tunable symmetries for applications in plasmonics. This presentation will also discuss the limits of this generality in the extreme of low supersaturation. A strategy for favoring localized deposition that differentiates between both different vertices and different edges or faces, i.e., regioselective deposition, will be demonstrated. Such regioselective heterogeneous nucleation was achieved at low supersaturation by a kinetic preference for high-energy defect-rich sites over lower-energy sites. This outcome was enhanced by using capping agents to passivate facet sites where deposition was not desired. Collectively, the results presented provide a model for breaking the symmetry of seeded growth and for achieving regioselective deposition.

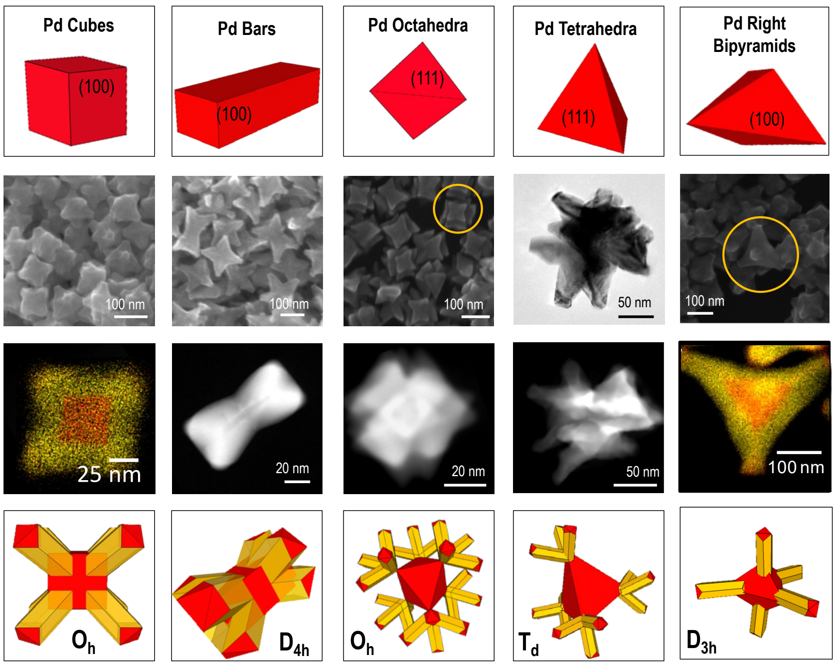

Figure 1. Examples of branched metal nanocrystals synthesized from shape-controlled seeds.

References

[1] R. G. Weiner, M. R. Kunz, S. E. Skrabalak, *Acc. Chem. Res.* 48 (2015), 2688-2695.
[2] A. N. Chen, M. M. Scanlan, S. E. Skrabalak, *ACS Nano* 11 (2017), 12624-12631.

Acknowledgements
US National Science Foundation, Division of Chemistry #1602476

Bio :

Dr. Sara Skrabalak received her B.A. degree in chemistry from Washington University in St. Louis in 2002 where she conducted research with Professor William E. Buhro. She was the recipient of the Sowden Award in undergraduate research from the Department of Chemistry. She then moved to the University of Illinois at Urbana-Champaign where she completed her Ph.D. degree in chemistry in fall of 2006 under the tutelage of Professor Kenneth S. Suslick. There, she was the recipient of the T.S. Piper Thesis Award for her work on porous materials. She then conducted postdoctoral research at the University of Washington – Seattle with Professors Younan Xia and Xingde Li, designing nanomaterials for biomedical applications. She began her independent career in the Chemistry Department at Indiana University – Bloomington in 2008, where she was named the James H. Rudy Professor in 2015. She is a recipient of both NSF CAREER and DOE Early Career Awards. She is a 2012 Research Corporation Cottrell Scholar, a 2013 Sloan Research Fellow, a 2014 Camille Dreyfus Teacher-Scholar, and recipient of the 2014 ACS Award in Pure Chemistry and 2015 Baekeland Award. In 2017, she was named both a Fulbright Fellow and Guggenheim Fellow as well as the recipient of Research Corporation's Frontiers in Research Excellence & Discovery Award. Her research group focuses on nanomaterial design and synthesis for applications in catalysis, solar energy use, secured electronics, chemical sensing, and more (http://www.indiana.edu/~skrablab/).