IOWA STATE UNIVERSITY

Department of Chemical and Biological Engineering

Graduate Seminar Series 2018-2019

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171 Durham Center

Iowa State University

Liquid Phase Electron Microscopy Imaging of Biological and Soft Materials

Microscopy aided in many important discoveries in life sciences. With the continuous development of new techniques, it is finally possible to visualize systems and dynamic processes in liquid phase with sub-nanometer resolution [1]. Our early work was focused on a correlative scanning TEM (STEM) and fluorescence microscopy technique for imaging viable cells of Magnetospirillum magneticum strain AMB-1 in liquid phase in situ using a fluid cell TEM holder [2]. Bacterial magnetite biomineralization is a complex and not fully understood process, and exploring new analytical approaches of characterization in situ opens new ways for the studies of dynamic processes in single cells with nanometer-scale resolution. This approach permits imaging fully hydrated cells of various biological specimens in their natural liquid environment with nanometer resolution [2,3]. The findings obtaining with using magnetotactic bacteria as model system lend themselves naturally to the investigation of many real-world samples. Our current liquid phase electron microscopy effort is focused on expanding this approach to imaging of other biological and soft materials. The systems of interest span from probing the interactions of living cells with engineered nanomaterials to monitoring biomass degradation [4], characterization of gel-based nanocomposites [5], and metallization of DNA origami triangles [6].

I will outline the latest development in liquid phase electron microscopy of soft materials in situ and discuss the ways to minimize the electron beam damage to the specimen.

[1] T. J. Woehl, T. Prozorov, "Future prospects in liquid cell EM of biomaterials" in Liquid Cell Electron Microscopy, Ed. F. Ross, Cambridge University Press, New York, NY, 476 – 500 (2017), ISBN: 9781-107-11657-3.

[2] T. J. Woehl, et al., Sci. Rep.4 (2014), 6854

[3] T. Prozorov, et al., J. R. Soc. Interface Mater. 14 (2017), 20170464.

[4] A. Londono-Calderon, et al., Microsc. Microanal. 24 S1 (2018), 282.

[5] A. Londono-Calderon, et al., Micron, (2018), under revision.

[6] A. Londono-Calderon, et al., Microsc. Microanal. 24 S1 (2018), 382.

Tanya Prozorov received her PhD in Materials Chemistry from the University the Illinois at Urbana-Champaign, USA in 2004 working on the applications of high-intensity ultrasound for synthesis and modification of nano-materials. In 2005 she joined the US DOE Ames National Laboratory focusing on bioinspired synthesis magnetic nanoparticles.

She was the recipient of DOE Early Career award and currently is a staff scientist at the Division of Materials Sciences and Engineering at the Ames National Laboratory, where her work is focusing on in situ TEM studies of nanomaterials in liquid cell.