Designing Janus Biointerfaces to Interrogate Immune Functions

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Understanding and controlling the response of immune cells holds great promise for the development of precision medicine, particularly for cancer immunotherapy. Functions of immune cells are known to depend on the intricately organized chemical reactions and physical forces. Examples range from the engulfment of invading bacteria that relies on a fine balance of competing mechanical forces, to the activation of T-lymphocytes that requires collective interactions between thousands of receptors at the junction between cells. Owing to the complexity of these processes, understanding immune functions using traditional biological tools is highly challenging. In this talk, I will present my group's research progress towards designing unique biointerfaces to enable the quantitative understanding and manipulation of immune functions. Our research so far has capitalized on Janus particles, which, like the two-faced Roman god Janus, are made chemically, biologically, optically or magnetically asymmetric. We developed Janus particle-based toolsets for measuring cell dynamics in multi-dimensions beyond translational motion and for spatiotemporally controlling cell functions. Using these methods, we uncovered new mechanisms in immune regulation and achieve spatiotemporal control of immune processes, from phagocytosis to intracellular trafficking, which would otherwise be difficult to access with traditional means.

Prof. Yan Yu is an Associate Professor in the Department of Chemistry at Indiana University Bloomington. She received her B.S. in Chemistry from Peking University (Beijing, China) in 2004, and Ph.D. in Materials Science and Engineering at the University of Illinois-Urbana Champaign in 2009 under the direction of Prof. Steve Granick. She completed her postdoctoral training with Prof. Jay T. Groves at the University of California at Berkeley from 2009 to 2012. Since starting her independent career in July 2012, Prof. Yan Yu has received numerous awards, including CAREER award from the National Science Foundation (2016), the Cottrell Scholar Award from the Research Corporation for Science Advancement (2016), and the Maximizing Investigators' Research Award from the National Institutes of Health (2017). She was named a Sloan Fellow in 2017 by the Alfred P. Sloan Foundation.