

On Tiles, Bowties, and Funnels

Dr. Bogdan Dragnea, Department of Chemistry, Indiana University

While proteomics, metabolomics, and the structural molecular biology methods allow us to map the cellular constituents, their chemistry and their arrangement, there are no direct methods at present that give enough detail on the mechanisms of organization of many important biomolecular complexes. For example, due to the large number of intermediates involved, viral self-assembly pathways are still poorly understood. A technique able to track the self-assembly process of a single virus would alleviate the limitations of real-time current methods, which average among intermediates. New methods are required for real-time studies of the dynamics of individual biomolecular complexes.

One of the goals of my laboratory is to develop such an instrument for the real-time detection of binding events between nanometer-size biological entities. The instrument is based on an addressable array of nanoscopic optical near-field sensors, which measure optical fluctuations induced by the presence of individual self-assembling biomolecules. The sensor detects changes in the hydrodynamic properties of a near-field trapped nanoparticle due to single molecular binding events, without the need for fluorescent markers. Besides the direct access to the mechanism of assembly, other practical advantages of the scheme include: physiological concentrations, single-molecule binding sensitivity on multi-molecular complexes, 0.1-10 ms time resolution, and possibility of massively parallel sensing.