Date: Thursday, November 28, 2024

Time: 10:30 AM – 11:30 AM (Coffee & cookies will be available before the talk at 10:15 AM)

Room: Biocenter 1 – HS (00.187), Hanns-Dieter-Hüsch-Weg 15

Multivalent Interactions: from bio-inspiration to bio-application

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Multivalency describes many types of interfacial interactions in Nature. For example, hemagglutinin coat proteins of the influenza virus bind non-covalently to multiple sialyl-terminated carbohydrates (SLNs) of a host cell. This interaction is weakly multivalent in nature, and therefore it responds very sensitively to the density of carbohydrates on the cell surface and to the individual affinity of the interacting molecular partners. This behavior explains the large differences between virus affinities observed for mutations in the receptor binding domain.

A key aspect of the multivalent interaction of viruses at cell membranes is its strong, non-linear dependence on the receptor density displayed at the surface. We here show the development of surface gradients of receptor-modified supported lipid bilayers (SLBs) to visualize and quantify the receptor density dependence in one microscopic image. This technique is called “Multivalent Affinity Profiling”. The fitting of the data by a thermodynamic model allows quantification of the threshold density, comparison of binding selectivities for different virus strains, and thus offers a molecular and quantitative understanding of the supramolecular binding energy landscape. This supramolecular and nanoscopic picture links fundamental molecular aspects of binding to biological processes of antigenic drift and zoonosis.

At a more general level, chemically modified interfaces can be used to study complex (bio)chemical recognition processes, such as the binding of viruses and DNA. Exquisite receptor or probe density control is achieved through surface receptor gradients and by poly-L-lysine chemistry with control over grafting density. Multivalent recognition events are probed and controlled at surfaces and in solution by molecular engineering of the interfaces of the involved building blocks. These concepts can, amongst others, be used to control the self-assembly of vesicles and other materials building blocks and to develop a method to isolate the cancer biomarker hyper-methylated DNA.