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Understanding dynamic changes in live cell adhesion with neutron reflectometry

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Understanding the structure and functionality of biological systems on a nanometer-resolution and short temporal scales is important for solving complex biological problems, developing innovative treatment, and advancing the design of highly functionalized biomimetic materials. For example, adhesion of cells to an underlying substrate plays a crucial role in physiology and disease development, and has been investigated with great interest for several decades. In the talk, we would like to highlight recent advances in utilizing neutron scattering to study bio-related structures in dynamic conditions (*e.g.* under the shear flow) including *in-situ* investigations of the interfacial properties of living cells. The strength of neutron reflectometry is its non-pertubative nature, the ability to probe buried interfaces with nanometer resolution and its sensitivity to light elements like hydrogen and carbon. That allows us to study details of cell - substrate interfaces that are not accessible with any other standard techniques. We studied the adhesion of human brain tumor cells (U251) to quartz substrates and their responses to the external mechanical forces. Such cells are isolated within the central nervous system which makes them difficult to reach with conventional therapies and therefore making them highly invasive. Our results reveal changes in the thickness and composition of the adhesion layer (a layer between the cell lipid membrane and the quartz substrate), largely composed of hyaluronic acid and associated proteoglycans, when the cells were subjected to shear stress. Further studies will allow us to determine more conditions triggering changes in the composition of the bio-material in the adhesion layer. This, in turn, can help to identify changes that correlate with tumor invasiveness, which can have significant medical impact for the development of targeted anti-invasive therapies.