Laminar flow devices for measuring the diffusional coefficients of proteins and protein complexes

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Laminar flow or streamline flow occurs when fluid flows in parallel layers, with no disruption between the layers. In laminar flow species transport perpendicular to the flow direction is dominated by diffusion. In microfluidics such flow conditions are ubiquitous due to the small conduit dimensions used in typical devices. It thus becomes possible to design diffusion limited transport devices for applications such as biochemical sensing and microreactors. In this paper we demonstrate the use of commercially available laminar flow microfluidic mixers for the measurement of protein diffusion coefficients. We describe the experimental setup and species transport theory used for measurement and analysis. As a proof-of-concept the system is further used to determine the coefficient of diffusion of green fluorescent protein (GFP). This platform can be used to study of protein-protein interactions in a variety of biological systems, mostly derived from bacteria and eukaryotic proteins involved in cancer. It will help to understand how and why proteins form complexes and what the functional consequences of these associations are.