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## Assessment of Molecular Diffusion in Polyelectrolyte Multilayer Matrix

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Assessment of molecular diffusion is of high importance in fields of drug delivery systems, biomaterial development, cell biology, etc. Assessment and comprehensive analysis of the diffusivity provides a deeper understanding of the diffusion phenomenon and heterogeneity of biomaterials. This insight eventually may lead to a rational control over the diffusivity. Fluorescence recovery after photobleaching (FRAP) is commonly employed to probe molecular diffusion by analysis of the recovery of fluorescence after photobleaching of fluorescently labelled molecules. Despite FRAP being a popular method, it is hard to analyze multi-fractional molecular diffusion due to limited possibilities of approaches for analysis. Here we present a novel simulation-optimization-based approach (S-approach) that significantly broadens possibilities of the analysis. In the S-approach, possible fluorescence recovery scenarios are primarily simulated and afterwards compared with a real measurement while optimizing parameters of a model until a sufficient match is achieved. This makes it possible to reveal multi-fractional molecular diffusion. The proposed S-approach is compared with a conventional, yet advanced analytical solution based approach (A-approach) which involves fitting an analytical solution of molecular diffusion to FRAP recovery profiles. The S-approach is superior for multi-fractional analysis compared to the analytical one, however, diffusion of a single population of molecule

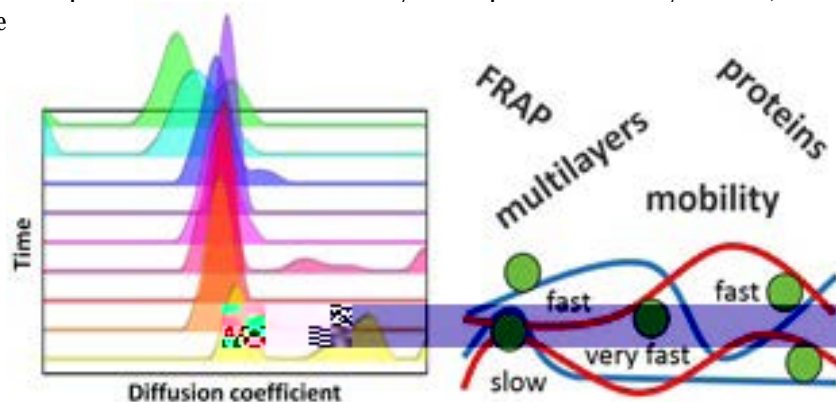


Figure 1: **Left:** Distribution of diffusion coefficients of cytochrome c loaded into (HA/PLL)<sub>24</sub> multilayers. **Right:** Schematics depicting various interaction states of cytochrome c in polyelectrolyte multilayer and corresponding keywords.

### Recent publications

1. Sustr D, Hlavacek A, Duschl C, Volodkin D (2018) Multi-Fractional Analysis of Molecular Diffusion in Polymer Multilayers by FRAP: A New Simulation-Based Approach. *The Journal of Physical chemistry B* 122,1323-1333
2. Selin V, Ankner JF, Sukhishvili SA (2017) Nonlinear Layer-by-Layer Films: Effects of Chain Diffusivity on Film Structure and Swelling. *Macromolecules* 50, 6192-6201.

3. Xu L, Selin V, Zhuk A, Ankner JF, Sukhishvili SA (2013) Molecular Weight Dependence of Polymer Chain Mobility within Multilayer Films. *ACS Macro Lett* 2, 865-868.
4. Velk N, Uhlig K, Vikulina A, Duschl C, Volodkin D (2016) Mobility of Lysozyme in Poly(L-lysine)/hyaluronic Acid Multilayer Films. *Colloids Surf. B* 147, 343-350.
5. Vogt C, Ball V, Mutterer J, Schaaf P, Voegel JC, Senger B, Lavalle P (2012) Mobility of Proteins in Highly Hydrated Polyelectrolyte Multilayer Films. *J. Phys. Chem. B* 116, 5269-5278.

## Biography

David Sustr has an expertise in polyelectrolyte multilayers, diffusion measurements, microscopy techniques and more. He gained these abilities during studies and work at Masaryk University (Czechia), University of Helsinki (Finland), University of Potsdam (Germany), and Fraunhofer IZI-BB (Germany). His motivation comes from an interest in understanding reasons of behavior and its relationships of various systems and materials.

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