Experimental report

13/02/2021

Proposal: CRG-2761 **Council:** 4/2020

Title: Conformational Change of Bioinspired Polymer Brushes Caused by Specific Capture of Heavy Metal Ion.

Research area: Soft condensed matter

This proposal is a new proposal

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Samples: Silicon
Phytochelatin

Instrument	Requested days	Allocated days	From	To
SUPERADAM	6	6	04/02/2021	09/02/2021

Abstract:

To clean up soil and water contaminated with hazardous contaminants using plants, called phytoremediation, relies on the ability of plants to concentrate contaminants from the environment and to detoxify with aid of a protein, phytochelatin (PhyCh) . For example, the dissociation constant of PhyCh to Cd2+ is Kd ~ 10−13 M, which is more than 10 orders of magnitude lower than the commercially used crown ether (Kd ~ 10−2 M). The main aim of the proposed project is to gain deeper insights into conformational changes of PhyCh-inspired polymer brushes at the solid/iquid interface. PhyCh-inspired polymers are grafted onto the surface of a supported membrane via biotin-neutravidin crosslinkers, which enables the precise control of lateral density of polymer brushes. Specular neutron reflectivity experiments at SuperADAM with an outstanding resolution in q enables us to sensitively detect subtle changes in the thickness, density, and roughness of polymer brushes in the presence of monovalent cations (e.g. Na+, K+) and divalent cations (Ca2+, Cd2+, etc.)

Experimental report to the proposal CRG-2761

Conformational Change of Bioinspired Polymer Brushes Caused by Specific Capture of Heavy Metal Ion.

The Lipid bilayer from vesicle suspension of deutrated lipids (D-DPPC) was deposited on Silicon-block (5 ×8 × 2 cm^3) and incubated solid-liquid measurement cell at T ~ 45°C for at least 3 hours prior to NR measurement (red cross, figure1A). In the next step neutravidin solution was injected into the cell and incubated for 3 hours at room temperature. After rinsing with Tris buffer the NR curve is recorded (green triangles, figure 1A). The later step is repeated for polymer brush Cys 5 (black squares, figure 1A).

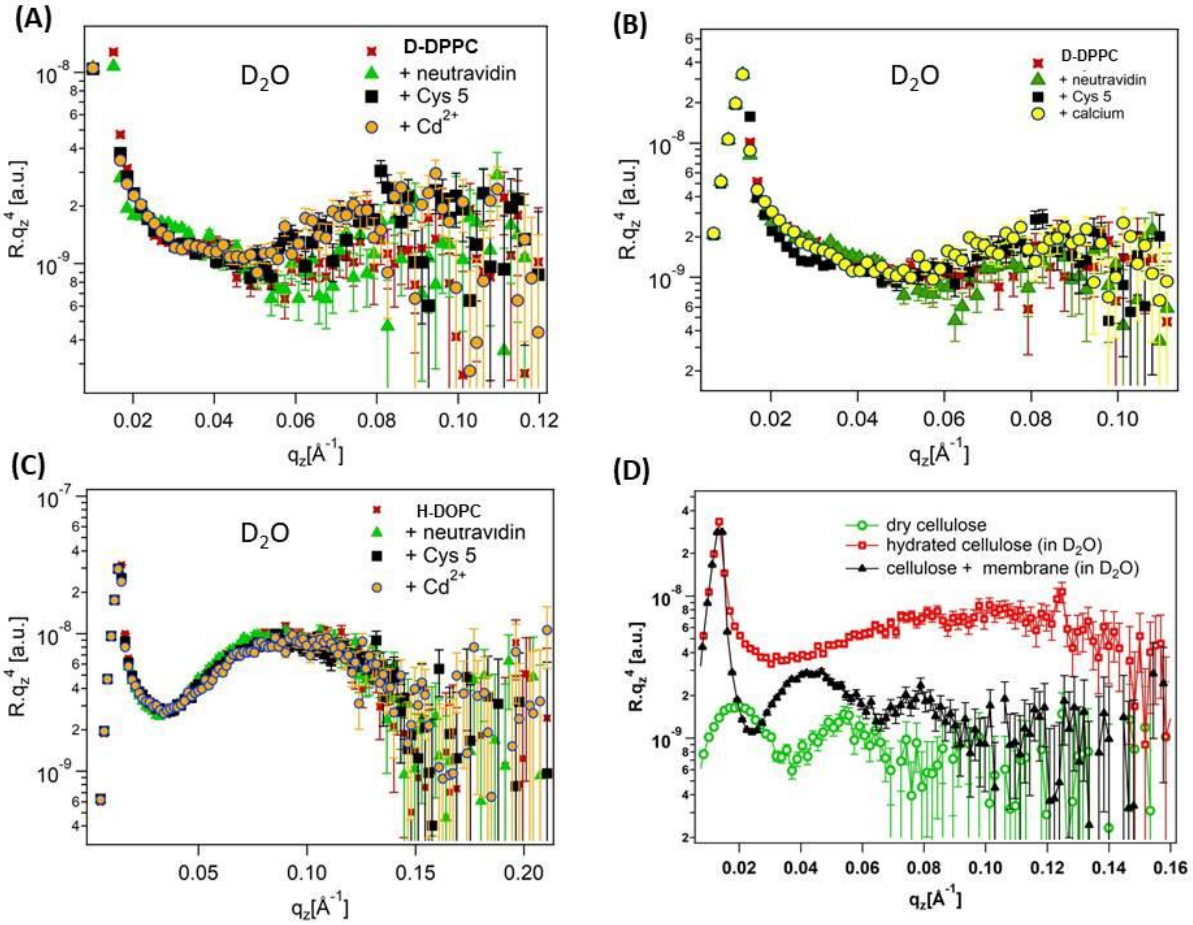

Figure 1: *(A) NR curves of polymer brush Cys 5 coupled to D-DPPC in the presence of Cd^{2+} ions and (B) in the presence of Ca^{2+} ions. (C) NR curves of polymer brush Cys 5 coupled to DOPC in the presence of Cd^{2+} ions. (D) NR curves of polymer supported membrane.*

Eventually, the subphase is exchaneged with Tris-buffer containing 1 mM $CdCl_2$ and NR curve was recorded after 3 hours of incubation at room temperature (yellow circles, figure 1A). The differences between NR curves are very small. However the global shape of the NR curve suggests that the quality of the bilayer is not very good. The same set of experiments were repeated and the final buffer is replced with Tris-buffer containing Ca^{2+} ions (figure1 B). The shift of NR curves toward lower q-values uppon addition of extra-layer (e.g. neutravidin, polymer brush cys 5) indicates the increase in total films thickness. Moreover, after the addition of Ca^{2+} ions the NR curve is shifted to higher q-value indicating that the polymer brush is cros-linked by Ca ions. However, the global shape of the NR curve suggests a low bilayer quality. The same set of measurement were repeated with deutrated DPPC is replced with hydrogenated H-DOPC (figure 1C). The NR curves indicates better bilyer qualitiy but the contrast between different films (neutravidin, Cys 5 and lipid bilayer) is low. At the end of the beam time polymer (cellulose) supported membrane is measured to confirm the possibility of depositing biological membranes on polymer support at macroscopic length sacle (5×8 cm^2) (figure 1D).