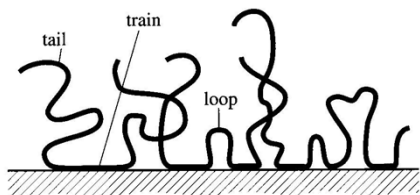


### polimeri na površini; adsorpcija polimera




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### višesloj (multilayer)?

- nastaju naizmjeničnom adsorpcijom polikationa i polianiona na čvrstu površinu
- najčešća metoda naizmjenično uranjanje u otopinu polielektrolita
- intenzivno istraživano posljednjih petnaestak godina (preko 100 radova godišnje)
- istražuju se uglavnom jaki polielektroliti

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### polikationi i polianioni; ponašanje na površini

- adsorpcija polielektrolita na kovinskim oksidima
- izmjenično dodavanje pozitivno i negativno nabijenih polielektrolita  $\Rightarrow$  nastajanje višesloja na površini metalnog oksida
- izrastanje višesloja je karakterizirano porastom adsorbirane mase  $\Rightarrow$  metoda praćenja reflektometrija

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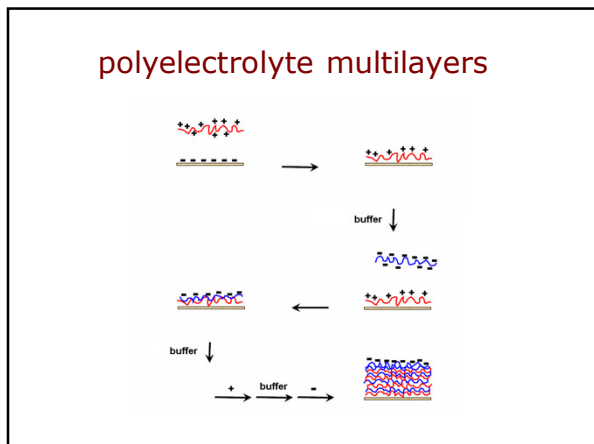
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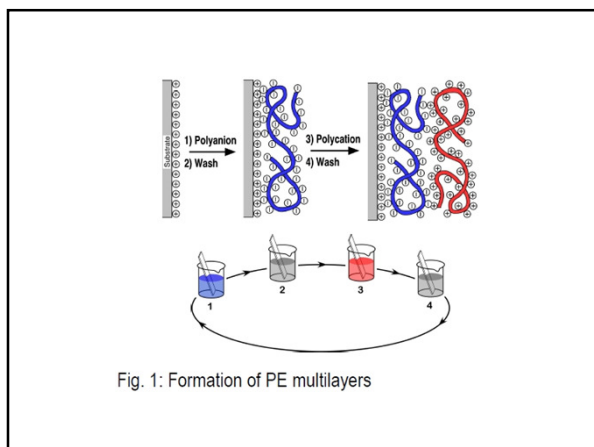
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### otvorena pitanja

- ponašanje slabih polielektrolita
- mehanizam nastajanja višeslojeva
- polielektrolitni višeslojevi su ravnotežne strukture?
- eksponencijalni vs. linearni rast

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## eksperimentalne metode:

- Elipsometrija
- ***Optička reflektometrija***
- Quartz crystal microbalance (QCM)
- Optical waveguide lightmode spectroscopy
- Surface plasmon resonance spectroscopy
- Neutron reflectometry
- FTIR-IR, AFM, itd, itd...

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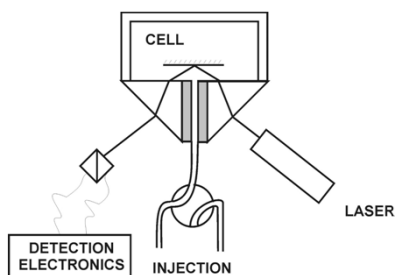
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## optička reflektometrija




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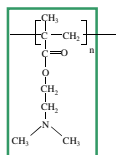
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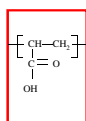
**P-AMA** Poli(di-metil-Amino-etil-MetAkrilat)



$M_w = 20 \text{ kg/mol}$

$M_s = 157 \text{ g/mol}$

**PAA** Poli Akrilna kiselina (Acid)



$M_w = 12.5 \text{ kg/mol}$

$M_s = 72 \text{ g/mol}$

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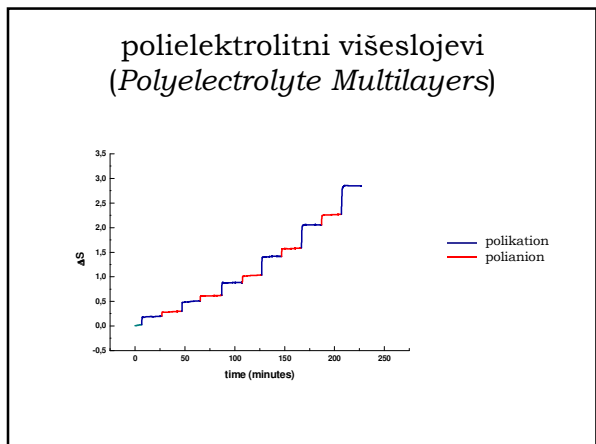
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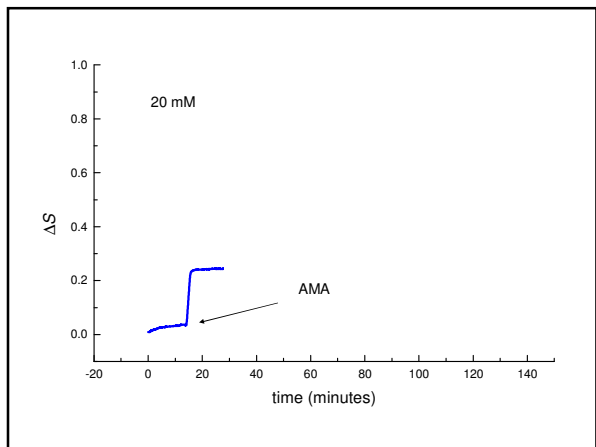
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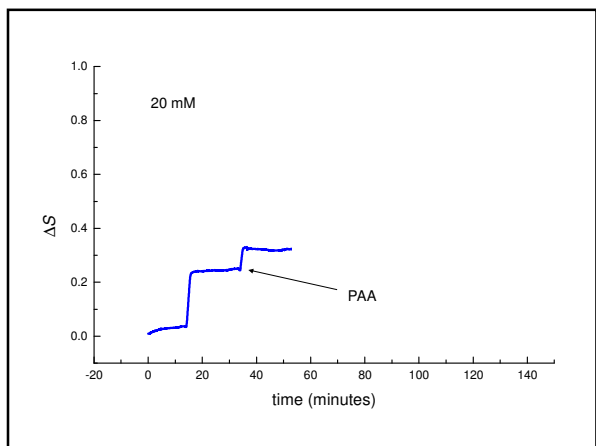
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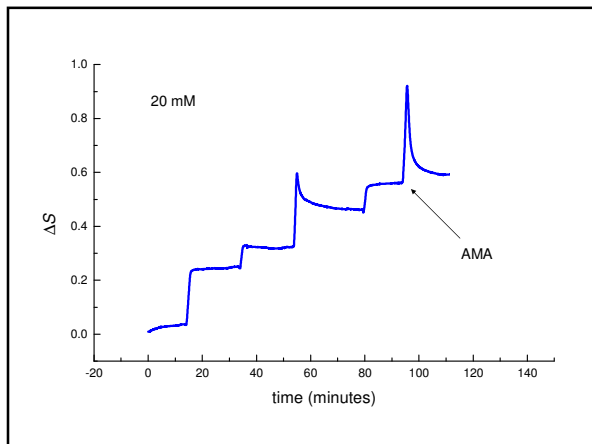
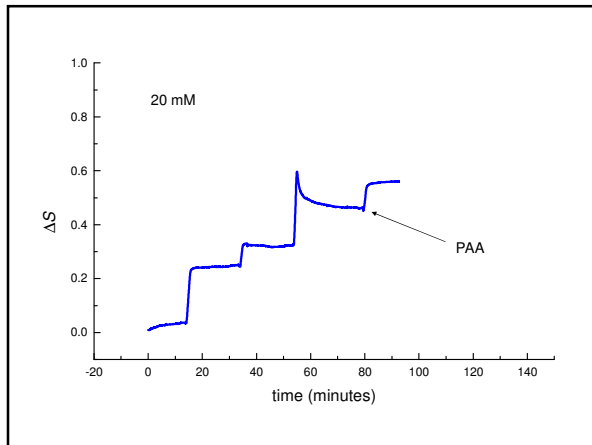
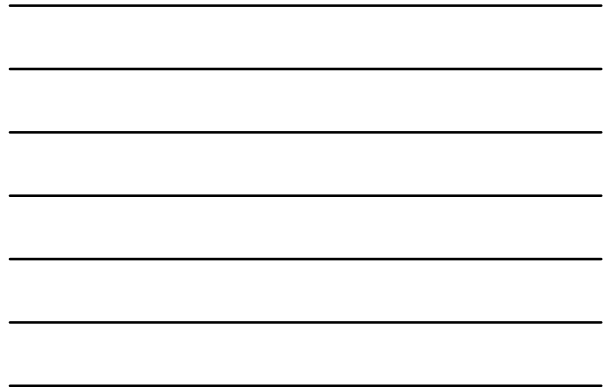
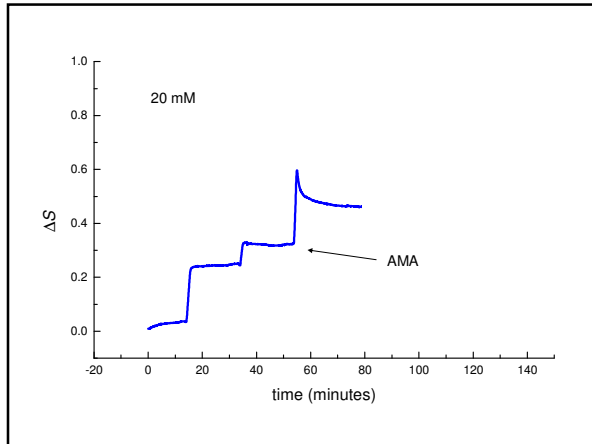
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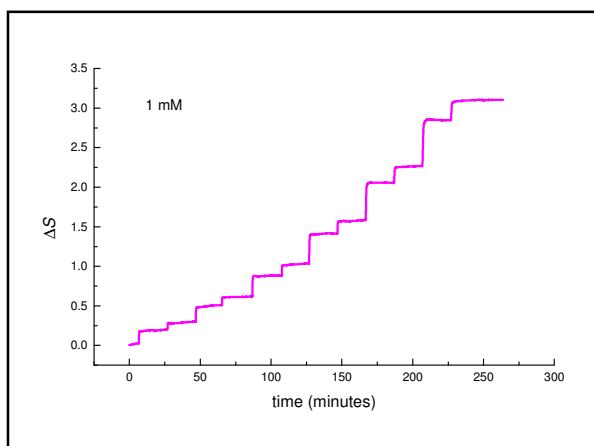
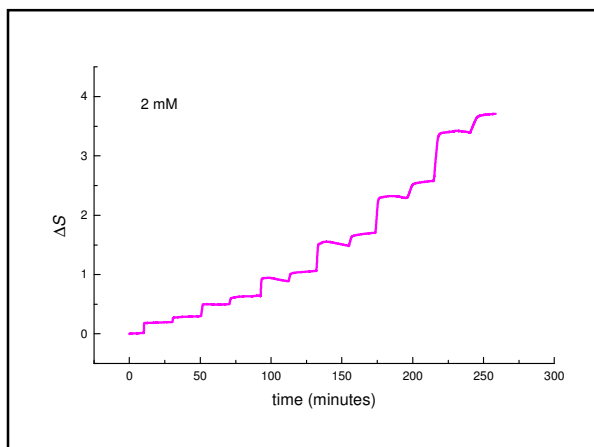
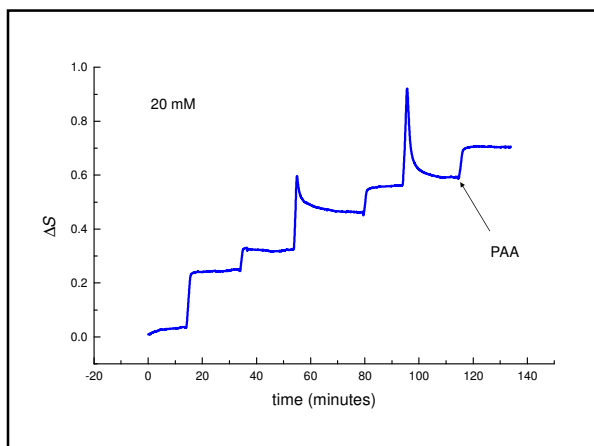
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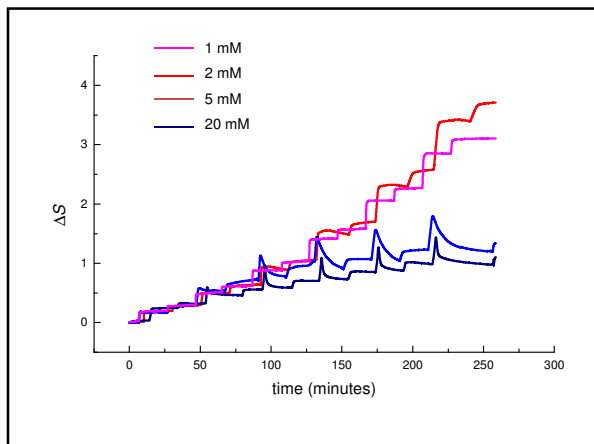
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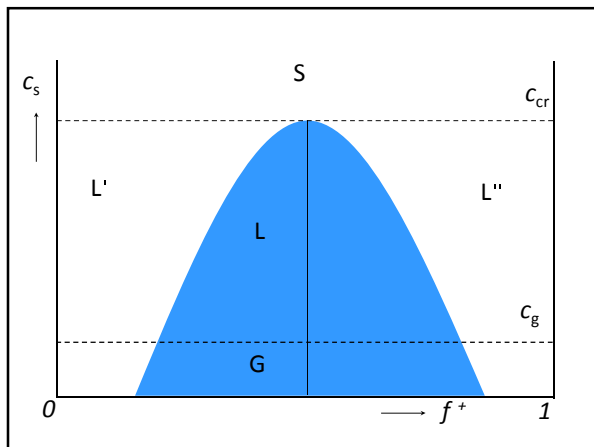
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**AFM mjerenja**

- usporedba između uzoraka pripremljenih pri 1 mM i 5 mM
- contact mode AFM

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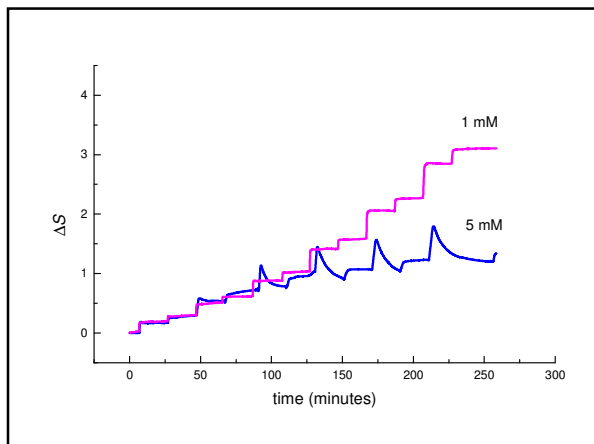
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### otvorena pitanja

- ponašanje slabih polielektrolita
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- polielektrolitni višeslojevi su ravnotežne strukture?
- eksponencijalni vs. linearni rast

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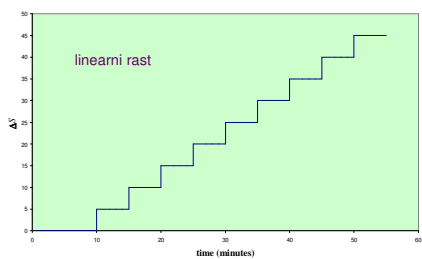
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### eksponencijalni vs. linearni rast




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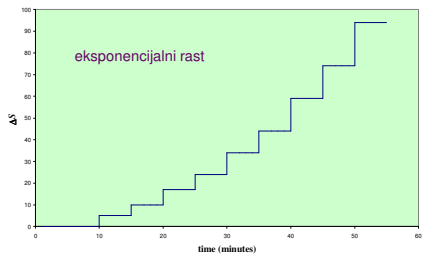
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### eksponencijalni vs. linearni rast




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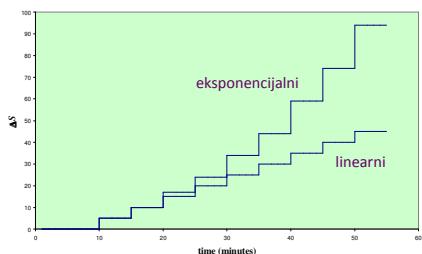
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### eksponencijalni vs. linearni rast




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### eksponencijalni vs. linearni rast

Faktori koji utječu na tip rasta:

- kemijska priroda polielektrolitnog para
- vrsta dodanog elektrolita
- ionska jakost
- temperatura
- metoda priprave

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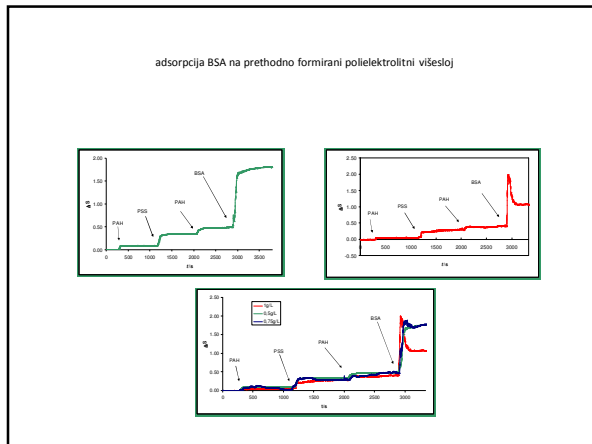
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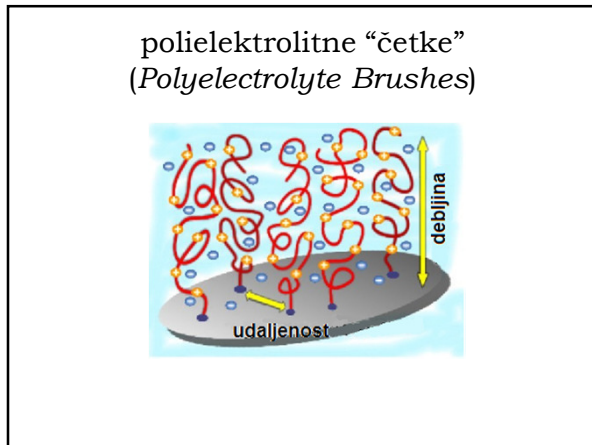
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polyelectrolyte multilayers - applications

Biomedicine and pharmaceutical industry

- Surface modification (thickness, charge, etc...)
- Drug delivery
- Formation of stimuli responsive systems (e.g. mechanical, temperature, pH)
- Surfaces with antibacterial properties

**Emerging applications of stimuli-responsive polymer materials**

Marlene A. Cohen Stuart, Wilhelm T. S. Huck, Jan Genies, Marcus Müller, Christopher Ober, Manfred Stamm, Gök B. Sukhorukov, Igor Stelzer, Vladimir V. Tsukruk, Mark Urban, Franziska Weirich, Stefan Zauscher, Igor Luzinov and Sergey Minko

Responsive polymer materials can elicit a wide range of responses, ranging from transport of ions and molecules, change in optical properties and in cell adhesion, to stimuli-induced self-assembly and changes in mechanical properties. These materials are playing an increasingly important part in a diverse range of applications such as drug delivery, diagnostics, tissue engineering and smart optical systems, as well as biosensors, microfluidic devices, coatings and textiles. We review recent advances and challenges in the emerging smart family applications of stimuli-responsive polymer materials that are well exemplified from nanostructured building blocks. We also provide a critical review of emerging developments.

Drastically Lowered Protein Adsorption on Microbicidal Hydrophobic/Hydrophilic Polyelectrolyte Multilayers

Seo Yoon Wyang<sup>1,2</sup>, Lim Han<sup>3</sup>, Kazuo Tamaguchi<sup>1,2</sup>, Junsu Yoo<sup>1,2,3</sup>, Jihyeon Noh<sup>1,2</sup>, Chongho Choi<sup>1</sup>, Alexander M. Kilian<sup>1,2,3</sup> and Pablo T. Hammond<sup>1,2</sup>

<sup>1</sup>Department of Chemical Engineering, <sup>2</sup>Center for Soldier Nanotechnology, <sup>3</sup>Department of Materials Science and Engineering, Department of Chemistry, Department of Biological Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139, United States

Reporting Information

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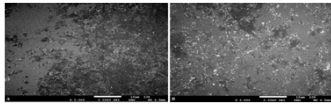
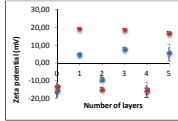
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adhesion of bacteria on polyelectrolyte multilayers



PAH/PSS multilayer

adhesion of bacteria *Pseudomonas aeruginosa* on PAH/PSS multilayer (SEM).  
 (A) five layers with positive terminating layer (PAH)  
 (B) six layers with negative terminating layer (PSS)

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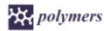
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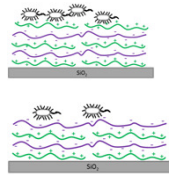
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Influence of Polyelectrolyte Multilayer Properties on Bacterial Adhesion Capacity

Dever Kovalevič<sup>1</sup>, Rok Pratošek<sup>1</sup>, Karmen Godič Torkar<sup>2</sup>, Jasmina Sabopk<sup>1</sup>, Goran Dzidič<sup>3,4,5</sup>, Anže Abram<sup>3,4,5</sup> and Klemen Bohinc<sup>1,2,6</sup>

	PAH as terminating layer (5 layers)	PSS as terminating layer (5 layers)
Fraction of the multilayer surface covered with <i>P. aeruginosa</i>	20.4% ± 4.8%	9.0% ± 3.1%
Contact angle	48.9° ± 2.5°	45.9° ± 5.0°
Roughness	0.017 μm ± 0.004 μm	0.019 μm ± 0.006 μm




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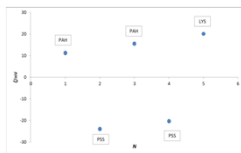
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adhesion of bacteria on protein-terminating polyelectrolyte multilayers



	Lycosyme as terminating layer (5 layers)	BSA as terminating layer (5 layers)	Glucanase as terminating layer (5 layers)
Contact angle	63.2° ± 0.1°	63.2° ± 6.0°	66.7° ± 9.4°
Roughness μm	0.100 ± 0.03	0.072 ± 0.00	0.018 ± 0.006
σ potential/mV	20.10 ± 0.35	7.24 ± 0.74	-11.77 ± 0.40

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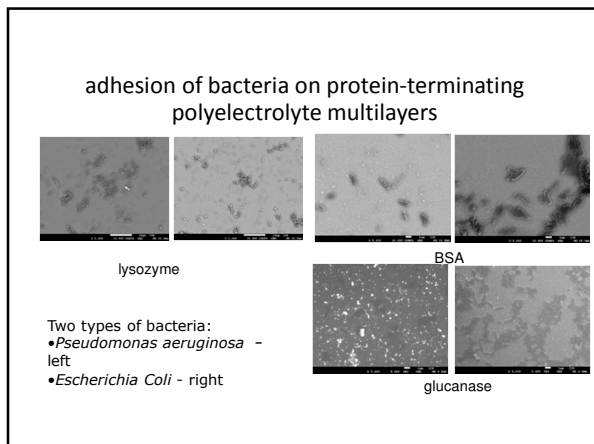
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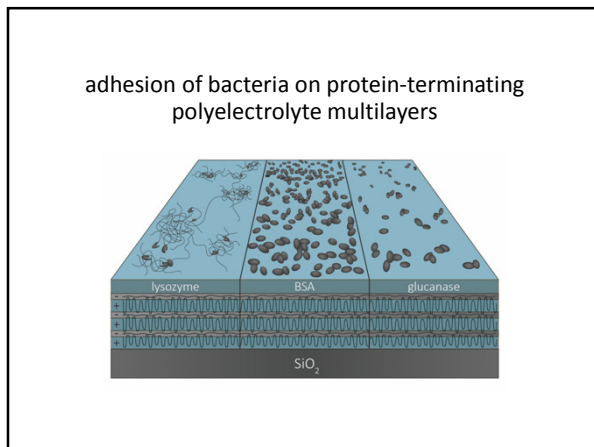
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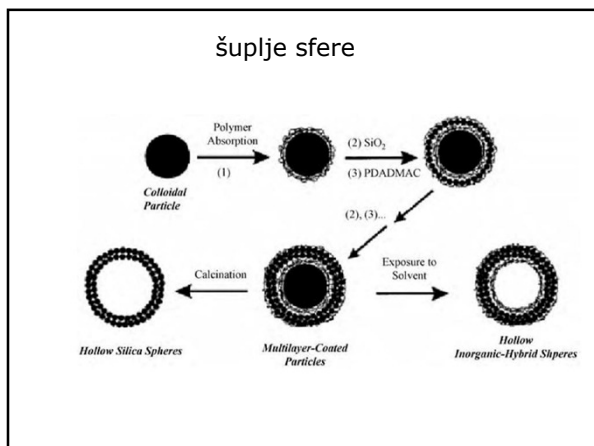
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