Biomolecular conjugation inside synthetic polymer nanopores via glycoprotein–lectin interactions

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Nanoscale, 2011, 3, 1894-1903

We demonstrate the supramolecular bioconjugation of concanavalin A (Con A) protein with glycoenzyme horseradish peroxidase (HRP) inside single nanopores, fabricated in heavy ion tracked polymer membranes. Firstly, the HRP-enzyme was covalently immobilized on the inner wall of the pores using carbodiimide coupling chemistry. The immobilized HRP-enzyme molecules bear sugar (mannose) groups available for the binding of Con A protein. Secondly, the bioconjugation of Con A on the pore wall was achieved through its biospecific interactions with the mannose residues of the HRP enzyme. The immobilization of biomolecules inside the nanopore leads to the reduction of the available area for ionic transport, and this blocking effect can be exploited to tune the conductance and selectivity of the nanopore in aqueous solution. Both cylindrical and conical nanopores were used in the experiments. The possibility of obtaining two or more conductance states (output), dictated by the degree of nanopore blocking resulted from the different biomolecules in solution (input), as well as the current rectification properties obtained with the conical nanopore, could also allow implementing information processing at the nanometre scale. Model simulations based on the transport equations further verify the feasibility of the sensing procedure that involves concepts from supramolecular chemistry, molecular imprinting, recognition, and nanotechnology.