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Optimization of Polyelectrolyte Multilayer Coatings for Biofunctionalization of Cardiovascular Stents by Incorporation of Grapheme Oxide

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Abstract. The use of polyelectrolyte multilayers (PEMs) fabricated by layer-by-layer (LbL) self-assembly of polycations and polyanions has emerged as a powerful and versatile strategy to engineer bioactive films for biofunctionalization of implantable biomedical devices and drug delivery. A wide variety of polyelectrolytes ranging from designed synthetic polymers to naturally derived biopolymers may be employed for film build-up and the resulting biomimetic PEM films are of special interest for coating medical implants. The main challenge is the construction of coatings with composition, thickness, and physicochemical properties that can be varied or tailored precisely on nanometer and micrometer scales to meet different medical requirements.

This study addresses the optimization of both the physicochemical properties and the surface biocompatibility of polyelectrolyte multilayers built from the natural, biodegradable, linear polysaccharides hyaluronan (HA) and chitosan (Chi) by incorporation of graphene oxide (GO) sheets into the polymer matrix. Owing to its remarkable electrical, thermal and mechanical properties GO (the most important derivative of graphene) has rapidly become one of the most widely studied materials in the last years. GO is a novel nanomaterial with two-dimensional structure (single sheets of carbon atoms packed in a perfect honeycomb structure) and a very large surface area, which has been considered as excellent nanoscale filler for improving the barrier properties of polymer films.

We constructed diverse hybrid HA/Chi/GO multilayers with different number and position of GO-layers inserted in the polymer matrix. We applied ellipsometry, quartz crystal microbalance (QCM), atomic force microscopy (AFM), Raman spectroscopy and contact angle technique, and demonstrated that GO sheets act as a strong polyelectrolyte and due to their negative charge adsorb successfully on positively charged Chi-layers. The insertion of GO into the polymer matrix influences the growth, thickness, morphology, macro- and micro-roughness, stiffness, and hydrophilicity of HA/Chi films and thus acts as a key to modulate the

PEMs interaction with biomolecules and cells.