

19<sup>th</sup> World Congress on

# Materials Science and Engineering

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### Two- and three-dimensional multilayer bio-coatings as novel drug delivery systems. From nano to micro

Polymer multilayers first introduced about two decades ago are nowadays widely used towards bio-applications in tissue engineering and regenerative medicine. Our research is focused on active 2D and 3D multilayer structures (e.g. planar films, capsules, beads) with tailor-made properties. Such structures have a fine-tuned architecture, controlled thickness from nano to macro, adjusted softness from Pa to GPa, almost unlimited variety of functional components, and externally activatable drug release. In this talk I present our recent findings in mild and effective immobilization of biomolecules (proteins, nucleic acids, small drugs, etc) and approaches for release/delivery the biomolecules in a controlled manner. The externally triggered release on demand by IR-laser light and cell biology studies including extra- and intra-cellular delivery will be considered. The developed structures offering localized, remote, and non-invasive release of biomolecules are indispensable for applications in tissue engineering, and especially for single cell studies where high precision of delivery in space and time is highly desirable.



### Recent Publications

1. Volodkin D & von Klitzing R (2014) Competing mechanisms in polyelectrolyte multilayer formation and swelling: Polycation–polyanion pairing vs. polyelectrolyte–ion pairing. *Curr Opin Colloid Interface Sci* 19: 25-31.
2. Volodkin D (2014) CaCO<sub>3</sub> templated micro-beads and -capsules for bioapplications. *Adv Colloid Interface Sci* 207: 306-324.
3. Prokopovic VZ, Duschl C & Volodkin D (2015) Hyaluronic Acid/Poly-L-Lysine Multilayers as Reservoirs for Storage and Release of Small Charged Molecules. *Macromol Biosci* 15: 1357-1363.
4. Vikulina AS, Anissimov YG, Singh P, Prokopovic VZ, Uhlig K, Jaeger MS, von Klitzing R, Duschl C & Volodkin D (2016) Temperature effect on the build-up of exponentially growing polyelectrolyte multilayers. An exponential-to-linear transition point. *PCCP* 18: 7866-7874.
5. Prokopovic VZ, Vikulina AS, Sustr D, Duschl C & Volodkin DV (2016) Biodegradation resistant multilayers coated with gold nanoparticles. Towards tailor-made artificial extracellular matrix. *ACS Applied Materials & Interfaces* 8: 24345-24349.

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## Biography

Dmitry Volodkin is Associate Professor at Nottingham Trent University and heads the group "Active-Bio-Coatings". He has studied Chemistry at the Lomonosov Moscow State University in Russia. Research stays brought him to France (University of Strasbourg) and Germany (Max-Planck Institute of Colloids and Interfaces, Technical University of Berlin, Fraunhofer Institute for Cell Therapy and Immunology). His research activities are focused on design of advanced stimuli-responsive biomaterials for applications in tissue engineering, diagnostics, toxicology, drug delivery. His group engineer self-assembled polymer-based 2D and 3D structures with tailor-made properties: multilayer films, microcapsules and beads, liposome-polymer composites, polymeric scaffolds, etc. Dmitry Volodkin has published more than 70 peer-reviewed articles/books and received a number of prestigious scientific awards such as Sofja Kovalevskaja Award of Alexander von Humboldt Foundation, Richard-Zsigmondy Price of German Colloid Society, Alexander von Humboldt Fellowship, Marie Skłodowska-Curie Fellowship.

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