POLYMERIC NANOCONSTRUCTS FOR THERANOSTICS
FROM IN-SILICO TO IN-VITRO AND PRECLINICAL STUDIES

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ABSTRACT

Multifunctional nanoconstructs are particle-based nano-scale systems designed for the 'smart' delivery of therapeutic and imaging agents. The Laboratory of Nanotechnology for Precision Medicine at IIT-GE synthesizes polymeric nanoconstructs with different *sizes*, ranging from a few tens of nanometers to a few microns; *shapes*, including spherical, cubical and discoidal; *surface* properties, with positive, negative, neutral coatings; and mechanical *stiffness*, varying from that of cells to rigid, inorganic materials, such as iron oxide. These are the *4S parameters* – size, shape, surface, stiffness – which can be precisely tuned in the synthesis process enabling disease- and patient-specific designs of multifunctional nanoconstructs. In this lecture, the role of manipulating these 4S parameters over different temporal and length scales will be elucidated in the context of future nanomedicines with applications in cancer, cardiovascular and anti-inflammatory diseases.

SHORT BIOGRAPHY

Paolo Decuzzi is a senior researcher and founding director of the Laboratory of Nanotechnology for Precision Medicine at the Italian Institute of Technology in Genova – Italy. Dr. Decuzzi earned his M.Sc. degree in Mechanical Engineering from the Politecnico di Bari (Italy) in 1997 and his Ph.D. degree in Mechanical Engineering from the University of Naples – Federico II (Italy) in 2000, with a thesis on friction and adhesion at the nanoscale. In 2002, he was nominated Assistant Professor of Machine Design at the Politecnico di Bari and, in 2005, he became Associate Professor in the School of Medicine of the University 'Magna Graecia'. There, he co-founded BioNEM - the laboratory of BioNanotechnology and Engineering for Medicine - one of the first nano-engineering laboratories built in a School of Medicine.

In October 2007, he joined The University of Texas Health Science Center in Houston as an Associate Professor of Biomedical Engineering. In October 2010, he moved to the Houston Methodist Hospital where he served as a Professor of Biomedical Engineering till July 2015. There, he founded the Center for the Rational Design of Multifunctional Nanoconstructs, with the financial support of the Cancer Prevention and Research Center of Texas and the US National Cancer Institute; and served first as the co-chair of the Nanomedicine Department and then as the interim chair of the Translational Imaging Department. In July 2014, Dr. Decuzzi was awarded a 5-year European Research Council "Consolidator Grant" to design, synthesize and develop nanoconstructs for imaging and therapy in brain cancer.

Dr. Decuzzi has published over 150 papers in international peer-reviewed journals, international conferences and book chapters. He holds over 5 patents in the field of Nanomedicine. He co-founded NEMB – NanoEngineering for Medicine and Biology – committee of the American Society for Mechanical Engineers and is involved in multiple dissemination activities to foster the collaboration between biomedical scientists and engineers. He serves on multiple study sections and review panels, including the NIH, ESF, the Italian Government, and other EU countries and funding agencies. His research activity is primarily supported by the European Research Council and the Marie Curie Sklodowska Action.

Decuzzi's lab mission is to **i.** rationally design polymeric nanoconstructs for multi-modal imaging and combination therapy in cancer, cardiovascular and neurological diseases; **ii.** fabricate microfluidic chips for the rapid screening of novel molecular and nano-based therapeutic agents; **iii.** develop multi-scale, hierarchical computational models for predicting the transport and therapeutic efficacy of nanoconstructs; **iv.** organize dissemination activities at the interface between engineering and biomedical sciences; and **v.** promote the professional development of lab members in a highly multi-disciplinary environment.