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Nanoscale Horizons Emerging Investigator Series: Dr Valentina Castagnola, Italian Institute of Technology, Italy

Our Emerging Investigator Series features exceptional work by early-career nanoscience and nanotechnology researchers. Read Valentina Castagnola's Emerging Investigator Series article 'Sources of biases in the *in vitro* testing of nanomaterials: the role of the biomolecular corona' (<https://doi.org/10.1039/D3NH00510K>) and read more about her in the interview below.



Dr Valentina Castagnola graduated with a Masters in Photochemistry and Molecular Materials, obtaining “*cum laude*” from the University of Bologna. In 2014, she earned a PhD in Micro and Nano Systems working at one of the laboratories of the National Center for Scientific Research (CNRS) in Toulouse, France. Her thesis focused on the development of soft implantable devices for recording neuronal signals and was awarded the best thesis prize by the GEETS (Génie Electrique, Electronique, Télécommunications et Santé) doctoral school. Then, she moved to Dublin to work at the “Center for Bionano Interactions” a Center of Excellence led by Prof. Kenneth Dawson and located at University College

Dublin, Ireland. Here, she specialized in the study of interactions between different nanoscale materials and the human biological environment, to foster the development of new therapeutic solutions based on nanomedicine. She is currently a researcher at the Italian Institute of Technology (IIT) and at the IRCCS Ospedale Policlinico San Martino in Genoa, Italy, where she pursues her research based on the study of the blood–brain barrier and the development of biomimetic systems as an innovative therapeutic platform for neurodegenerative diseases. In 2020 she was awarded the prestigious “Roche for Research” award.

Read Valentina Castagnola's Emerging Investigator Series article 'Sources of biases in the *in vitro* testing of nanomaterials: the role of the biomolecular corona' (<https://doi.org/10.1039/D3NH00510K>) and read more about her in the interview below:

NH: Your recent *Nanoscale Horizons Communication* evaluates the biases existing in typical *in vitro* studies assessing nanomaterial toxicity and therapeutic efficacy and showcases 10% fetal bovine serum in an *in vitro* assay. How has your research evolved from your first article to this most recent article and where do you see your research going in future?

VC: My research evolution from my first article is the result of my personal and professional growth coming from

my experience in different laboratories, in different countries, and the enriching encounters with great scientists. In these years, I have undertaken a very multidisciplinary pathway, touching on different topics, from microfabrication of brain implantable devices to nano-bio interactions and nanomedicine. The leading thread, though, has always been the investigation of how manmade materials with functional properties can function in a biological environment.

My research on the topic of the biomolecular corona started in 2015. At the time, I was in my first postdoctoral position, investigating the variety of scenarios occurring when nanomaterials are in contact with biological fluids and developing novel strategies to study such phenomena in different contexts. After almost 10 years of studies, my research underwent a significant evolution to a higher awareness of the intricacies related to the nano-bio world that are holding back the clinical development of nanomedicine. My desire now is to promote the development of novel, robust, and shared protocols to shorten distances to translational applications of nanomaterials (as intended in our recent *Nanoscale Horizons Communication*). I am optimistic because I feel this is more and more becoming a joint mission shared by several important scientists in nanomedicine.

In light of the considerations revolving around the actual biological identity of nanomaterials, in the future, I would love to focus on the study of the bio-nano interaction and potential therapeutic application of biomimetic systems (nanoscale objects with an endogenously defined biological identity). Bringing with them all the biological complexity, these hybrid nanomaterials are still quite challenging to manipulate with precision but certainly hold immense potential for novel therapeutic opportunities.

NH: How do you feel about Nanoscale Horizons as a place to publish research on this topic?

VC: *Nanoscale Horizons* is a perfect house to spread a message that aims to sensitize a community of scientists, pinpointing issues and proposing future directions as the journal actually aims to promote “new concepts or a new way of thinking (a conceptual advance) rather than primarily reporting technological improvements”. For this reason, in 2017 I published my first *Nanoscale Horizons* article entitled “Towards a classification strategy for complex nanostructures” (<https://doi.org/10.1039/C6NH00219F>), which featured on the front cover. The focus was related to biases on the nanomaterial side and how different geometrical features of nanostructures (even within the same batch) can influence the organization of biomolecules around them. In this last article, “Sources of biases in the *in vitro* testing of nanomaterials” (<https://doi.org/10.1039/D3NH00510K>), we approach the issue from the biomolecular side, highlighting complementary aspects of the same problem, therefore remaining coherent with the overall message.

NH: What aspect of your work are you most excited about at the moment?

VC: In general, the things that make the research work exciting for me are basically two-fold: the moment we feel we are grasping some new mechanism and all the new questions that this understanding brings along, and the teamwork with the younger scientists who share the same passion with you.

At the moment, we are working with hybrid systems based on bacteriophages, which seems to be extremely promising when applied to a nanomedicine context, and we are particularly excited to understand the details of their interactions with the cell machinery. This will help us to design highly performant hybrid nano-bots.

NH: In your opinion, what are the most important questions to be asked/answered in this field of research?

VC: The field of nanomedicine has been strongly questioned in recent years as many of the promises of the first *in vitro* success were not kept *in vivo*. The truth is that nanomedicine should still be considered a field in its infancy, especially if compared to disciplines (such as molecular and pharmaceutical science) that have had hundreds of years of evolution.

In the last 20 years, we have succeeded in identifying the major issues hampering the translation of nanoformulations to clinical settings. I think the most important question now is to understand what are the key players that will allow us to predict and control the biological behavior of nanomaterials in complex biological fluids, cells and organs.

NH: What do you find most challenging about your research?

VC: As regards my research on nanobio interactions, I believe the challenge is to be effective in synergizing the different disciplines necessary to tackle the problems, the multidisciplinary, and the dialogue between experts in the fields of biology, chemistry, and physics. Also, I find it challenging to be synchronized as a nano-community around a solid basis of nomenclatures, categorizations, and protocols, as is the case for the classic molecular chemistry field.

NH: In which upcoming conferences or events may our readers meet you?

VC: I will be presenting at the upcoming NanoMedicine International Conference – NanoMed 2024, from 23rd to 25th October in Barcelona, Spain.

NH: How do you spend your spare time?

VC: I particularly like to catch up on all the artistic expressions that I neglect when I am focused on science: literature, cinema, theater, and music. I also like practicing yoga, playing volleyball or tennis, traveling, or simply being with family and friends.

NH: Can you share one piece of career-related advice or wisdom with other early career scientists?

VC: Always question your results and discuss them with other scientists, don't be discouraged by failures (actually, don't even label them this way!), and keep a good life/work balance. It is important not to get lost in the contingency of the research but to have an open gaze on the world remaining creative and receptive.