Development of nanofluidic devices for DNA detection and nanoparticles sizing.

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Nanofluidic sensors are becoming even more interesting for several applications both in biomedical and environmental fields. In particular, during last years, their employment in the study and characterization of several objects at nanoscale are becoming very crucial.

In this work, we used different planar elastomeric nanofluidic devices, fabricated first using focused ion beam (FIB) milling technique and then a Poly(DiMethylSiloxane) (PDMS) based REplica Molding (REM) process [1], for distinguish, count and size, a very wide range of nanoparticles (NPs) and biomolecules.

In particular, we have optimized this manufacturing process using hard-PDMS (h-PDMS) that, having a higher Young's modulus, allows to avoid the structural collapse of nanostructures that occurs during the sealing process, a fundamental step for obtaining a watertight device.

Then, combining this optimized fabrication process and the particular nanodevice geometry with RPS technique [2] it was possible to analyze translocation processes and the NPs motion inside the nanochannel, acquiring electrical signals under constant voltage application. Specifically, considering the nanochannel dimension we were able to detect and count successfully small molecules (DNA) and NPs as transient variation in current during translocation event allowing a label-free sensing. Definitively, we have demonstrated the possibility of counting nanoparticles depending on selected characteristics (i.e. charge and size ranging from 40nm to 100nm) that is a crucial step useful in many fields such as medicine (drug delivery, imaging, cell-secreted carriers), environment (groundwater remediation), food production (nano-agrochemicals, nano-encapsulated additives, anti-microbials), and public health (nanotoxicology, risk assessment).

[1] Fanzio et al. *Lab on chip* (2011) 2961-2966
[2] Angeli et al. *Nano Letters*, (2015) 5696–5701