Implantable and bioresorbable chemical sensors for in-vivo tracking of clinical/diagnostic markers

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Imagine your doctor could slip a miniaturized sensing system under your skin and use it to continuously monitor the concentration of almost any molecule in real-time as it circulates through your peripheral blood. This would revolutionize many areas of diagnostics, enabling individualized reports on both disease progression and drug efficacy to be achieved continuously, in real-time. Imagine the sensing system implanted under your skin to communicate with your mobile phone (wireless communication) to transfer the clinically relevant data (biomarker or drug concentration) directly to your doctor. This would impact the way we diagnose diseases and monitor drug efficacy, currently based on single-moment-in-time tests, enabling personal, timely, and effective medical feedback (real-time personalized medicine). Finally, imagine the biochemical sensor in your body is resorbed upon a click, once you don't need it anymore. This would eliminate any need for sensor retrieval, avoiding risks connected to surgery and providing a risk-free "red button" to destroy it, in case issues will occur (e.g., end of the therapeutic process, inflammation, malfunctioning).

In this lecture, cutting-edge research on the use of bioresorbable nanostructured materials for the development of implantable bioresorbable sensors for analytes of clinical interest (e.g., drugs, biomarkers, ions) in-vivo, in-situ, and in real time that completely dissolve with biologically benign by-products after use will be will reviewed and discussed.

References

[1] Paghi, M. Corsi, A. A. La Mattina, G. Egri, L. Dähne, and G. Barillaro, Wireless and Flexible Optoelectronic System for In-Situ Monitoring of Vaginal pH Using a Bioresorbable Fluorescence Sensor, *Advanced Materials Technologies, 2201600* (2023). DOI: 10.1002/admt.202201600

[2] M. Corsi, A. Paghi, S. Mariani, G. Golinelli, A. Debrassi, G. Egri, G. Leo, E. Vandini, A. Vilella, L. Dähne, D. Giuliani, and G. Barillaro, Bioresorbable Nanostructured Chemical Sensor for Monitoring of pH Level In Vivo, *Advanced Science,* 2202062 (2022). DOI: 10.1002/advs.202202062

[3] A. A. La Mattina, S. Mariani, G. Barillaro, Bioresorbable Materials on the Rise: From Electronic Components and Physical Sensors to In Vivo Monitoring Systems, *Advanced Science*, 1902872 (2020). DOI: 10.1002/advs.201902872

[4] S. Mariani, V. Robbiano, L. M. Strambini, A. Debrassi, G. Egri, L. Dähne, G. Barillaro, Layer-by-layer biofunctionalization of nanostructured porous silicon for high-sensitivity and high-selectivity label-free affinity biosensing, *Nature Communications*, 9, 5256, 1-13 (2018). DOI: 10.1038/s41467-018-07723-8