

Nanobiosensors and applications in diagnostics

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Abstract

Nanomaterials (NM) with electrical and optical properties are playing a key role in the design of cutting edge biosensing technologies. Electrocatalytic, plasmonic and quantum properties of NMs such as gold nanoparticles, quantum dots or graphene while operating in simple plastic or paper matrix in diagnostic and safety/security applications will be shown. The effect of the platform architecture and other chemical and physical parameters upon biosensing and actuation including nano/micromotors pick-up or mixing operations will be discussed. The developed smart nanobiosystems are with interest for integration of diagnostic with therapies (nanotheranostics) or sensing and destruction/removal (sensoremoval) for health and environment industries. Examples related to protein (ex. neurodegenerative disease biomarkers), DNA (pathogen related) or cells (cancer cells) with interest for point of care applications will be shown. The developed devices and strategies are intended to be of low cost while offering high analytical performance in screening scenarios beside other applications. Special emphasis will be given to lab-on-a-chip platforms with integrated electrochemical detection with interest for either clinical or environmental monitoring (including sensoremoval). In addition simple paper-based platforms that operate in lateral flow formats with interest for heavy metals or protein detection will be shown. Various enhancement technologies ranging from microfluidics architectures changes, in-chip re-circulations as well as actuation via nano/micromotors able to either pick-up analytes or improve reaction medium in solid-liquid phase sensing technologies will be discussed.

References

1. C. Parolo, A. Merkoçi, "Paper based nanobiosensors for diagnostics", *Chem. Soc. Rev.*, 42 (2013), 450–457
2. A. M. Lopez_Marzo, J. Pons, D. A. Blake, A. Merkoçi, "All-Integrated and Highly Sensitive Paper Based Device with Sample Treatment Platform for Cd²⁺ Immunodetection in Drinking/Tap Waters", *Anal. Chem.*, 85 (2013), 3532–3538
3. E. Morales-Narváez, A. R. Hassan, A. Merkoçi, "Graphene oxide as a pathogen-revealing agent: sensing with a digital-like response", *Angew.Chem.Int.Ed.* 52 (2013), 13779–13783.
4. E. Morales-Narváez, H. Montón, A. Fomicheva, A. Merkoçi, "Signal Enhancement in Antibody Microarrays Using Quantum Dots Nanocrystals: Application to Potential Alzheimer's Disease Biomarker Screening", *Analytical Chemistry*, 84 (2012), 6821–6827
5. A. Escosura-Muñiz, A. Merkoçi, "Nanochannels Preparation and Application in Biosensing", *ACS Nano* 6 (2012), 7556–7583
6. E. Morales-Narváez, M. Guix, M. Medina-Sánchez, C. C. Mayorga-Martinez, A. Merkoçi, "Micromotor Enhanced Microarray Technology for Protein Detection", *Small* 2014, 2542–2548.
8. E. Morales-Narvez, A.-R. Hassan, A. Merkoçi, Graphene Oxide as a Pathogen-Revealing Agent: Sensing with a Digital-Like Response, *Angewandte Chemie*, 52, 13779–13783, 2013