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EDITORIAL

# Surface architectures for analytical purposes

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Nowadays we have no doubt that surfaces exist, we recognize that their physicochemical properties are different from those of the bulk, we exploit this fact for a variety of fundamental studies and applications, and surface science is a mature and distinct discipline. It was not so in the past, when surfaces were a matter of lively debate among ancient philosophers. The thoughts of Plato, Aristotle, and Posidonius in favour or against the existence and definition of surfaces, and the historical excursus of the surface concept during the centuries has been well reviewed (Paparazzo E. (2003) Surfaces—lost and found, Nature 3:351–353). The claim of Wolfgang Pauli that the bulk of a body was created by God while the devil invented the surface is further proof of the concern that scientists had and still have about surfaces. Perversely, the mixture of attraction and distrust surfaces exerted on researchers stimulated the development of instruments and strategies able to guarantee scientists full control of them.

Once scientists became confident of dominating surface chemistry and physics, they went as far as issuing the challenge of fabricating and manipulating nano-sized materials, for which the surface effects are enormously amplified. Nowadays functionalization of nano-patterned or nano-structured surfaces and surface engineering approaches are mature technology and are formidable tools in a plethora of applications in different fields. In analytical chemistry, surface architecture is designed and developed mainly for use in applications in which selectivity is needed, e.g. separation science, recognition assays, capture/release of drugs, sensors. Several approaches are available for building a suitable molecular recognition interface, the choice being related to the principles of transduction, and the nature of the receptor and the analyte. Generally speaking, a crucial point is immobilization of the receptor, which can be accomplished by adsorption, physical entrapment, covalent binding, or use of a chemical and/or biochemical "capture system". These approaches may take advantage of a variety of surface-engineering techniques, for example self-assembly of monolayers (SAM), Langmuir–Blodgett (LB), Langmuir–Schafer (LS), layer by layer assembly (LBL), surface functionalization, molecular imprinting in polymers (MIP), nanoscale patterning, and chemical or physical vapour deposition.

This issue covers a broad range of examples of surface architecture designed and realized mainly for fabrication of highly selective and highly sensitive sensing devices able to meet today's challenges in analyte detection and discrimination. A series of reviews present the state of the art spanning from functionalization of nano-structured materials for DNA detection to construction of protein layered architecture for recognition of biomolecules; from viable cell immobilization to molecular template integration for detection of analytes of medical, toxicological, and environmental interest; from interlocked surface-attached architecture for ion recognition to the many configurations of active components in organic field-effect transistors for detection of organic and/or inorganic species of biological interest.

Reviews critically discuss crucial issues which affect more or less all classes of sensors and in some cases still limit their performances and/or prevent their use in real life; important aspects of these are immobilization of the recognition element, which should preserve its chemical and/or biological functionality, and the integration between recognition element and transducer. Moreover, insights are provided on problems related to miniaturization, stability, reliability, and low-cost production, and future perspectives for each class of sensing device are emphasized.

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