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Analytical Concepts and Tools for Speciation Studies

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Speciation studies, *i.e.* the determination of the proportions and physico-chemical properties of the various species of a chemical substance, receive increasing attention as they set the basis for environmental management (*e.g.* pollution monitoring, water treatment), process control (food industry), and biomedical analysis. Historically, speciation has dominantly dealt with trace elements, but these concepts are now applied to organic substances, such as hydrophobic contaminants (*e.g.* PAHs, pesticides).

At the CABE (Analytical and Biophysical Environmental Chemistry) group, one of the research interests is to study the role of speciation of chemical substances on the transport of these substances through (bio)interfaces (Fig. 1). For this purpose, we develop and apply analytical tools for dynamic speciation.[1,2] We focus on bioanalogical sensors[1] based on permeation liquid membrane,[3,4] voltammetry,[1,3,5] and liquid-phase microextraction (Fig. 2). These sensors are based on the measurement of the fluxes of given chemical species through their interface[1–3] (Fig. 2b and d). These fluxes can be used in models to predict the bioavailability of chemical species.

These techniques have been applied in the laboratory, *e.g.* to investigate the association of trace elements with aquatic colloids,[5,6] biological exudates,[5] and antibiotics.[7] In addition, they were used to study trace element biouptake of biological systems such as algae[6] and plant roots.[5] These analytical tools have also been deployed to perform *in situ* measurements of trace metal speciation in fresh and seawaters[3,4,5,8] and to study biogeochemical cycles.[8]

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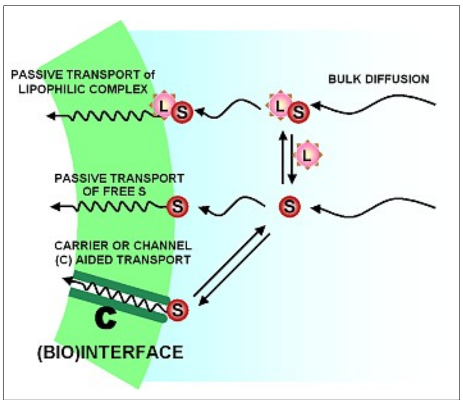

Fig. 1. Examples of mechanisms for the transport through a biointerface of a chemical substance **S** (*e.g.* an inorganic or organic pollutant) in the presence of a complexant **L**.

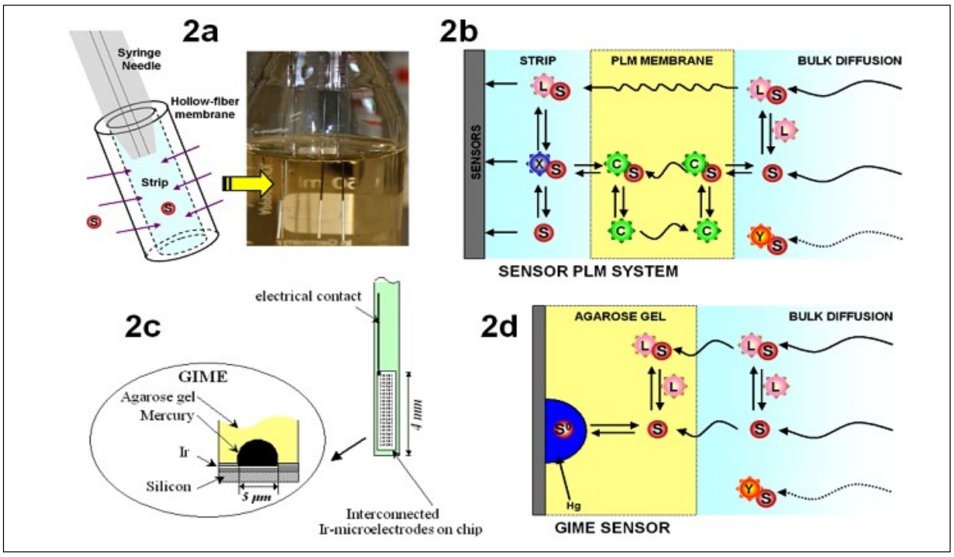

Fig. 2. Analytical tools for dynamic speciation studies, based on permeation liquid membrane (PLM) (a, b) and gel integrated microelectrodes (GIME) coupled with voltammetric detection (c,d). Schematic representation of chemical processes occurring at the sensor/solution interface for PLM (b) and GIME (d) devices. S: chemical substance of interest (metal or organics), L: complexant, C: carrier, X: strip complexant, YS: non reactive complex.