

Nanoparticles in aqueous environments: Electrochemical, nanogravimetric, STM and AFM studies

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Electrochemical and piezo-nanogravimetric (EQCM) studies in combination with atomic force and scanning tunneling microscopy (AFM,STM) have been used for characterization and determination of chalcogenide nanoparticles in model solutions and natural samples. Different electrode surfaces (Hg and Au) were used to give more details relating to attachment, adsorption, deposition and interaction between selected nanoparticles and functionalized electrode surfaces.

Mercury electrodes preconcentrate some metal sulfide nanoparticles effectively, enabling their detection at submicromolar concentrations. Voltammetrically active metal sulfides are accumulated on Hg electrode surfaces by two mechanisms: a) adsorption of nanoparticles to an electrode where they undergo reduction at -0.9 to -1.35 V (vs. Ag/AgCl), and b) formation directly at the Hg electrode surface in supersaturated metal sulfide solutions; the latter produces an analytical artifact [1]. In the case of FeS nanoparticles, anodic oxidation of Hg by FeS at around -0.45 V is the operating mechanism for their determination in aqueous solution [2].

By following changes in resonance frequency accompanied with some changes in current produced during oxido-reduction processes, it is possible to characterize physico-chemical properties and to calculate the mass of nanoparticles deposited on the Au surface over a broad range of environmentally relevant solution characteristics, including variation in ionic strength, composition and particle sizes. Particle deposition mechanisms are studied in relation to variations of particle charge, particle size and applied electrode potential, all with the aim to improve and develop new analytical methods for fast, selective, qualitative and quantitative nanoparticle characterization in natural waters.

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[1] Bura-Nakić *et al.* (2007), *Anal. Chim. Acta* **594**, 44-51. [2] Bura-Nakić *et al.* (2011), *Electroanalysis*, in press.

The largest deposit of strategic REE, Bayan Obo, geological situation and environmental hazards

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Bayan Obo Fe-Nb-REE super large deposit in Inner Mongolia is the main source of REE in the world and makes China the monopolist producer of these strategic elements. A typical feature of the Bayan Obo super large deposit is the presence of polymetallic Fe-Nb-REE mineralization in 3 different ores - disseminated, banded and massive. The principal REE bearing minerals are bastnaesite [(Ce,La,Nd)(CO₃)F] followed by monazite [(Ce,La,Nd)PO₄] in disseminated and banded ores. Magnetite and hematite are the dominant Fe-ore minerals in massive ores. Mining process in grassland and ore processing in Baotou bring several environmental hazards. Actual risk assessment is contaminated dust by Th and heavy metals, and it's transporting by sand storms to X00 km in main direction to SE (Peking capital). Leaching of old-mined ore is responsible for contamination of soil and ground water collectors by heavy metals and radioactive thorium (bastnaesite and monazite ores contain up to 0,5% ThO₂). The harm to environment of the past is mainly ore processing causing dominantly water contamination. Presently the ore processing is ecologically and economically well-developed under supervision of Baotou Institute of rare earth elements.