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EDITORIAL

Electrochemistry and mineral processing

The overall level of technical development of all societies is closely related to the assortment and quality of mineral resources used. The very names of the Stone, Copper and Iron Ages indicate the main and most important substances used by humans in those times. Unlike in those periods, today the modern industrial society utilises almost all elements of the periodic table. Owing to the development of mineral processing technologies, the production of most of the elements became economically acceptable even on an industrial scale. Practically all resources mined in the world (nearly four millions tons per day) are subjected to froth flotation. In that sense, at present, mineral processing has become the widest industrial application of solid state electrochemistry. This is not an overstatement, as flotation started to be transformed from an art to a science with a growing understanding of the electrochemical nature of the elementary processes leading to flotation. Solid state electrochemistry of minerals became one of the rapidly developing branches of electrochemistry. Redox transitions of minerals, transport of ions and charging of mineral surfaces, electroreduction of dissolved oxygen and accompanying processes of oxidation of minerals and reagents (collectors), wettability and catalytic phenomena – all these matters became the subjects of detailed research. Cyclic voltammetry, rotating disk electrodes, spectro-electrochemical techniques and other modern experimental methods now routinely accompany studies of mineral processing. New electroanalytical techniques like the voltammetry of immobilised microparticles and the voltammetry of mineral particles immobilised on electrodes using new polymeric binders have become extremely useful for studying weakly conductive minerals. Developing electrodes that rely on the surface conductivity produced by activating a non-conductive mineral with silver, copper or other metals has opened new possibilities.

The variable and changeable composition of all phases of a flotation process causes problems in obtaining comparable and reproducible data. Even the smallest quantities of impurities can drastically change not only the floatability of a mineral but its electrochemical and physical properties as well. Areas of different types of conductivity can be observed on a single sample of a natural mineral. Despite, or rather owing to, effects caused by small excesses of components in natural minerals and the instability of their characteristics, such minerals could be interesting for working out new perspective materials for sensors, batteries and fuel cells. For example, the electrocatalytic activity of some pyrites in the reaction of oxygen electroreduction is comparable to the activity of platinum group metals. Some zinc, molybdenum, cadmium and lead sulfides possess rather high photoelectrochemical activities.

Today the flotation practice has gone far ahead of the theory, thus inspiring the researchers to look deeper into the fundamentals. The variety of chemical compositions, structures and semi-conducting properties of natural minerals give unique opportunities for elucidation of the effects of the mass and charge transport processes in the bulk of a mineral and at its interfaces in electrochemical kinetics. Fundamental studies can initiate development of new applications in practice. In such a way, the inherent link between heterogeneous catalysis and electrochemistry leads to the creation of a new class of flotation reagents – catalysts.

Bioelectrochemistry and electrocatalysis open exceptional possibilities for selective leaching of gold and nonferrous metals. Bacterial leaching of gold has become the most effective operation in gold processing. I am sure that the solid state electrochemistry of minerals should become the basis for integration of the geochemical modification of ores into the processes of mining, mineral processing and electrochemical mineral leaching for optimal recovery of the valuable components. A multitude of experimental techniques shall be employed to solve these complicated problems – and I mean not just the electrochemical techniques but of course also all available *in situ* and *ex situ* techniques, e.g. scanning probe microscopy, diffraction techniques, etc. I very much hope that the *Journal of Solid State Electrochemistry* will become a suitable tribune for scientists interested in this exciting new field.

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