

Galvanic interactions affecting the reactivity of sulfides minerals

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Galvanic interaction between semiconducting sulfide minerals has been widely reported. It plays an important role in hydrometallurgical operations, such as flotation and leaching^{1,2}. The results of different studies performed by our research group are summarized in order to show the usefulness of the carbon paste electrodes in the analysis and detection of galvanic interaction between sulfide minerals.

The first case of the galvanic interaction shown in this work corresponds to the galvanic protection of pyrite by very low concentrations of mineralogical impurities (sphalerite, ZnS and galena, PbS at approx. 2%) contained in a sulfide concentrate (Fig. 1). The reactivity of pyrite was analyzed by cyclic voltammetry, where it was observed that when the mineralogical impurities are in contact with pyrite, this sulphide exhibits a lower reactivity (Fig 1 curve a) than when the impurities have been removed (Fig 1 curve b). Therefore, the elimination of mineralogical impurities from pyrite concentrate provokes its electrochemical reactivation. The mineralogical impurities were eliminated by leaching with deionised water at pH 5 (simulated meteorological water)³. It is worth noting that leaching of sphalerite and galena was promoted by the same galvanic interaction that protects the pyrite dissolution. When another sample of pyrite without mineralogical impurities was analyzed, this effect was not observed.

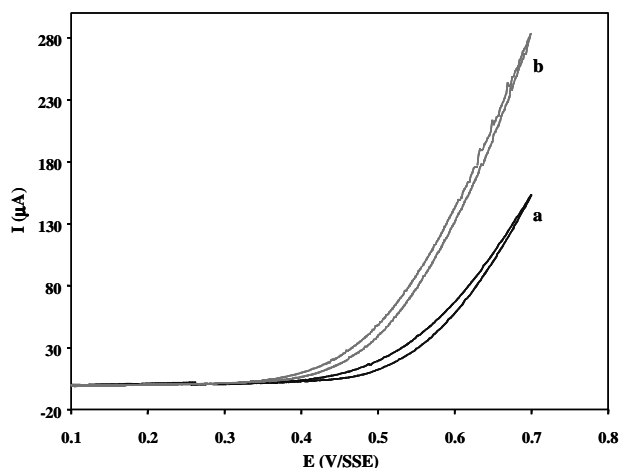


Fig 1.- Electrochemical reactivity of pyrite (a) with mineralogical impurities and (b) after removal of the mineralogical impurities. The voltammetric responses were obtained from CPE-Mineral 50% in 0.1 M NaNO₃. The scan was initiated in positive direction at 20 mV/s.

The second case shown in this work corresponds to the galvanic effect between pyrite and silver sulphide contained in a concentrate, during its oxidation in cyanide media. For this research, direct pulse chronoamperometry was used. Three different concentrates were analyzed: silver sulfide analytical reagent (99.9995%, SSAR), silver

sulfide (97.5%, Acanthite and 2.5% pyrite as impurity) and iron sulfide (99% pyrite).

The typical I(sampled)-E curves constructed from the corresponding chronoamperograms for the above mentioned concentrates are shown in Fig.2 at a sampling time of 1.0s. The tendencies of SSAR and Acanthite are similar at the lower potentials. However, at more positive potentials (>-0.100 V/HgO), the form of the curves change: in SSAR (Fig.2a) the current seems to reach a constant value while in Acanthite (Fig.2b), the current begins to increase. This behavior may be attributed to the silver sulfide-iron sulfide associations contained in Acanthite, which form a galvanic pair that first diminishes the oxidation of the sulfide ions originating from the silver sulfide. This reveals the great influence exercised by the iron sulfide contained in Acanthite, even though it is present only in minute quantities. On the other hand, the galvanic pair of the silver sulfide also affects the oxidation of iron sulfide. The results for the pyrite concentrate (Fig.2c, not shown) indicate the most important oxidative processes appear at much more positive potentials (0 V/HgO) than those of Acanthite. However, the galvanic pair between pyrite and acanthite explains the significant oxidation of the pyrite in the mineral⁴.

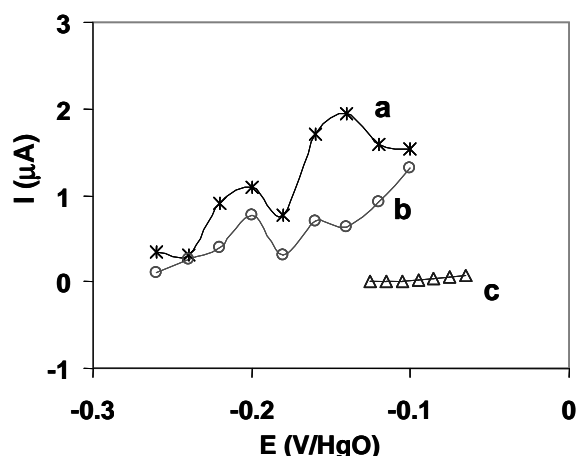


Figure 2. Sampled current-potential constructed from potentiostatic current transients for the concentrate-CPE (30 % w) in aqueous solution [CN⁻] = 0.3 M at pH = 10.60. a) Silver sulphide analytical reagent (SSAR), b) Acanthite and c) Pyrite. The current was sampled at t=1 s.

References

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