A FTIR spectroelectrochemical study of anodic processes on galena and pyrite electrodes

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FTIR spectroscopy is now the dominant tool for *in situ* studies of reactions at the electrode–electrolyte interface since it can provide structural, chemical, and dynamic information about the electrode surface and the double layer with surface sensitivity on the order of 0.1 monolayer [1]. We employed these advantages for studying *in situ* anodic processes on galena [2–5] and pyrite electrodes in the potential range of –0.5 to +0.8 V (SHE) under open-air and oxygen-free conditions in borate buffer (pH 9.18) in the absence and presence of a collector (*n*-butyl xanthate at 10^{-5} and 10^{-3} M). New results and advantages of the methodology used are discussed.

The spectra were measured applying a FTIR spectroelectrochemical (SEC) technique [6] that was specially devised for measurements on natural sulfide electrodes. As opposed to the techniques that were used in the previous FTIR SEC studies of the xanthate–sulfide system [7,8], the author's technique 1) allows measurements of spectra simultaneously with voltammograms; 2) is free from diffusion constrains and spectral artifacts; 3) is more flexible experimentally; and 4) has a higher surface sensitivity. To analyze qualitatively the molecular orientation, the spectra in the presence of 10^{-5}-M xanthate were measured with s- and p-polarization. To unravel the mechanisms of the anodic reactions, not only vibrational bands of interfacial species but also potential-dependent changes in the background absorption due to free carriers and surface states were analyzed. Moreover, potential-induced changes in the frequency and intensity of the δH_2O band of interfacial water were used for monitoring the corresponding changes in the relative hydrophobicity/hydrophilicity of the sulfide surface.

This approach made it possible to determine for the first time *in situ* the chemical identity and structure of the surface species that form at the galena and pyrite electrodes. Based on the complex analysis of the FTIR spectra, elementary steps of the galena and pyrite oxidation were specified. These new results were compared with the results that were obtained previously but by XPS and classical methods used in electrochemical and flotation reserach. The sulfide flotation–potential dependences found in the literature were interpreted based on the new data on the surface composition/structure. In addition, it was shown that dependences of the "spectral" hydrophobicity/ hydrophilicity on the electrode potential correlate with the flotation curves.

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