

## **6. Conclusions**

The adsorption of ethyl xanthate on Pd-Bi-Te and PtAs<sub>2</sub> has been studied using voltammetry, impedance measurements and Raman spectroscopy. Pd-Bi-Te and PtAs<sub>2</sub> electrodes show strong anodic currents when polarized at 0.3V(SHE) in a 0.05 M Na<sub>2</sub>B<sub>4</sub>O<sub>7</sub> solution containing 1 x 10<sup>-3</sup> M potassium ethyl xanthate. No chemisorption prewave could be identified. Pd-Bi-Te shows very strong anodic activity when polarized at potentials > 0.2V (SHE) in the presence of potassium ethyl xanthate. Prolonged exposure (20 minutes) of Pd-Bi-Te at this potential resulted in lower capacitance values. The lowering of the capacitance is a result of the formation of a continuous surface layer. Cathodic and anodic polarization curves predicted a mixed potential higher than that of the equilibrium xanthate-dixanthogen couple. As a result the increased anodic activity and the formation of the layer are likely to reflect the formation of diethyl dixanthogen on the surface.

Raman spectroscopy has confirmed that the strong anodic currents found on both minerals reflect the oxidation of xanthate to dixanthogen. Furthermore, Raman spectroscopy has confirmed the co-presence of xanthate with dixanthogen indicating that xanthate retains its molecular integrity when it adsorbs on the surface of the Pd-Bi-Te. The identification of both species on the surface of the Pd-Bi-Te suggests that SERS occurs on Pd-Bi-Te. However, this phenomenon could not be identified on the PtAs<sub>2</sub>. The formation of dixanthogen on the surface of the PtAs<sub>2</sub> is “instantaneous” (meaning that it occurs within the 120s required to measure a Raman spectrum) whilst dixanthogen could only be identified on the Pd-Bi-Te after longer periods of polarization. However, chemisorbed xanthate could be identified on the surface of the Pd-Bi-Te within 120 seconds; this yields a hydrophobic surface as indicated by electrochemically-controlled contact angle measurements. Maximum contact angles of 63° were measured in the case of Pd-Bi-Te. The presence of xanthate and dixanthogen on the surface and the fact that the surface is hydrophobic suggest that the poor flotation recovery of the Pd-Bi-Te minerals from flotation feeds cannot be attributed to a lack of interaction of the collector with the surface.

The flotation kinetics of Pd-Bi-Te has been studied and compared with that of natural copper and iron sulphides by performing single mineral microflotation tests. The microflotation tests showed that Pd-Bi-Te floats rapidly, with rates slightly exceeding that of (fast-floating) chalcopyrite. This supports the previous electrochemical results, which showed xanthate oxidation (to dixanthogen) at the mineral surface. The Ralston model predicts a sharp drop-off in flotation rate constants for small (<5  $\mu\text{m}$  diameter) Pd-Bi-Te particles. The conclusion is that small particle size is a probable cause for the low recoveries of Pd-Bi-Te at platinum concentrators along the Great Dyke of Zimbabwe.