Micro-Raman spectroscopic imaging of copper ores

Kostudis, S.[1,*], Hof, M.[2], Kutschke, S.[1], Pollmann, K.[1]

[1]Helmholtz Institute Freiberg for Resource Technology, Germany
[2]Technische Universität Bergakademie Freiberg, Germany
**e-mail: s.kostudis@hzdr.de*

The large deposits of Kupferschiefer in Middle Europe involve the northeastern part of Saxony, the Upper Lusatia. The regional copper shale raised again interest of both industry and science because it's copper content constitutes the most important natural copper resource in this region. Due to the complex composition of the shale including copper and sulfide rich ores, carbonates and organic compounds, there is no efficient biotechnological approach applied yet. Bioleaching, which means the use of microorganisms and their metabolites to extract metals from their ores, reduces costs of high energy input and avoids the usage of toxic chemicals thus benefitting environment (Narayan and Sahana 2009) and employees.

Raman spectroscopy enables a fast and specific chemical identification of minerals and ores (Hope et al. 2001) as well as changes e.g. caused by oxidation (García-Meza et al. 2012). Also Raman spectroscopic imaging of biotic components such as biofilms has already been performed (Virdis et al. 2012).

We aim to use Raman spectroscopy to investigate the interactions of microorganisms and ore surface: Different polished sections of bornite, chalcopyrite (both from Henderson Mine, Namaqualand, South Africa), chalcosite (Japan) and copper shale (Polkovice, Poland) were analysed by polarising microscopy to ensure correct spectra assignment (Figs. 1, 2). Subsequently identic areas were analysed by Raman imaging using 2D scanning function (Figs. 3–5). After incubation with microorganisms the sections will be investigated again in order to evaluate chemical changes of the ore surfaces, biofilm formation and to monitor bioleaching processes.

Fig. 1. *White light image, reflected light, 500×.*

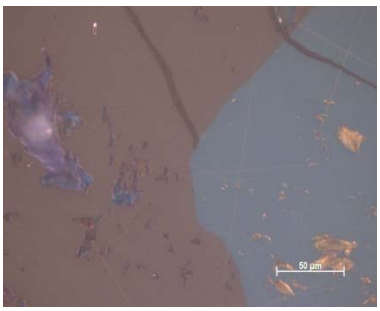

Fig. 2. *Cross-polarised transmitted light, 500×.*

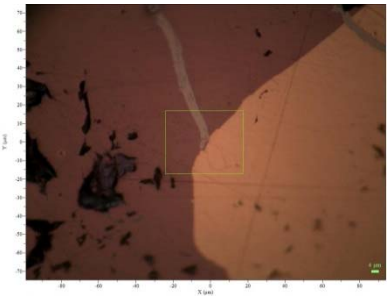

Fig. 3. *Raman mapping site (see small rectangle).*

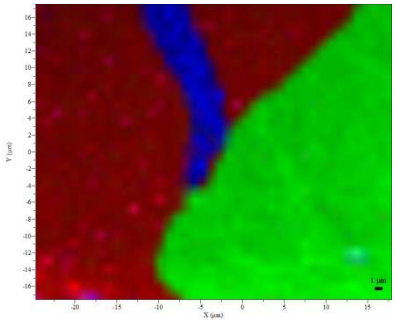

Fig. 4. *False colour image from Raman data.*

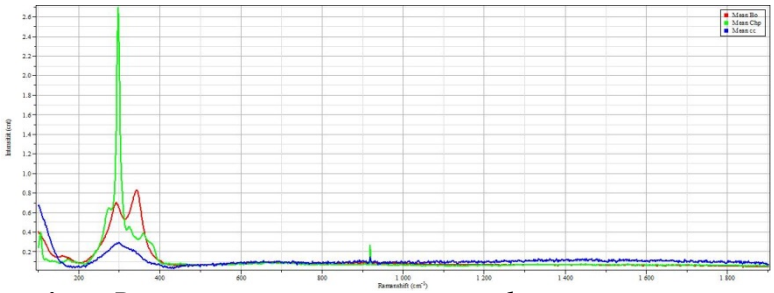

Fig.5. *Raman average spectra according to areas in Fig. 4.*

Acknowledgments: *Best thanks to Axel Renno, Michaela Rossner and Andreas Bartzsch for their constant support.*

References:

Narayan SJ, Sahana S (2009) Bioleaching: A review. Res J Biotechnol 4:72–75

Hope GA, Woods R, Munce CG (2001) Raman microprobe mineral identification. Miner Eng 14:1565 – 1577

García.Meza JV, Lara RH, Navarro-Contreras HR (2011) Application of Raman spectroscopy to the biooxidation analysis of sulfide minerals. Intern J Spectrosc 2011:501706

Virdis B, Harnisch F, Batstone DJ, Rabaey K, Donose BC (2012) Non-invasive characterization of electrochemically active microbial biofilms using confocal Raman microscopy, Energ Environ Sci 5:7017–7024