The copupled chemistry of In and Au studied by X-ray absorption spectroscopy of synthetic crystals

DMITRY TONKACHEEV[1], OLGA FILIMONOVA[1], ALEXANDER TRIGUB[2], KRISTINA KVASHNINA[3], SARA LAFUERZA[4], DMITRY CHAREEV[5]

[1]IGEM RAS, Moscow, Russia (correspondence:tonkacheev@igem.ru)
[2]Kurchatov Institute, Moscow, Russia
[3]ESRF, Grenoble, France
[4]HZDR, Dresden, Germany
[5]IEM RAS, Chernogolovka, Russia

The main source of In is sphalerite (Zn,Fe)S which also can host industrial concentration of Au. We use X-ray absorption spectroscopy to investigate the coupled chemistry of In and Au in synthetic sphalerite crystals. Both metals are homogeneoulsly distributed within the sphalerite matrix. The concentration of Au strongly depends on the fugasity of S_2 in the experimental system. However, their position within the mineral are different. In accordance with EXAFS spectra revealed that In replaces Zn in the structure of sphalerite. The In-ligand distance increases by 0.12Å and 0.09-0.10Å for the 1st and 2nd coordination spheres, respectively, in comparison with pure ZnS. The In-S distance in the 3rd coordination sphere is close to one in pure sphalerite. The XANES and EXAFS spectra suggest that there is no In-Au clustering. Gold in sphalerite is coordinated with 2.5±0.3 atoms at the Au-S distnance of 2.35±0.01 Å in the 1st coordination sphere, whereas distant coordination spheres have disordered nature. Our data suggest that at least two different forms of Au are present in sphalerite. At high Au concemtration (0.03-0.5 wt.%) are nanosized Au_2S clusters predominate, probably with small admixture of the Au in the solid solution characterized by higher Au-S distance. The concentration of Au in pure sphalerite do not exceed 10 ppm. The financial support for this study was provided by Russian Science Foundation (grant#14-07-00693-P).