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Comments regarding the proposed alternative hypothesises to the observed copper corrosion and hydrogen evolution, 2009-12-08

Several different hypothesises for the observed copper corrosion and hydrogen release has been proposed during the last year, for instance by Willis Forsling and Timo Saario. We have considered all of those hypotheses and they are not covering up for all our observations and furthermore, they require some revision of known thermodynamic data. The latter is of course not impossible, but not very likely. Most of these hypothesises are based on combinations of well known thermodynamic equilibrium reactions in order to explain our observations.

Each individual equilibrium reaction takes place to some extent and some are more significant than others. When combining those proposed reactions with all known reactions/thermodynamic data, preferably with the use of a software such as THERMO CALC or HSC-chemistry, it is found that the equilibrium hydrogen partial pressure in the system Cu-H_2O is for instance 10^{-12} bar at 80°C [1)]. This pressure is lower than the detection limit in most of our instruments, but it still means that copper is expected to react with water molecules and is not immune in pure water.

Several of the alternative hypotheses are based on formation of $Cu(OH)_2$ as explanation of our detected hydrogen release. If those hypotheses are right, the thermodynamic data for this phase (or ions) must be considerable modified, since the equilibrium H_2 pressure at 80°C for $Cu(OH)_2$ is only 10^{-16} bar according to SGTE-database [1)].

Our hypothesis, with formation of a monovalent amorphous CuOH-phase can explain the detected hydrogen release without changing the known thermodynamics of copper corrosion; it only implies an addition of tabulated thermodynamic data.

Several facts support our hypothesis:

- H_2-detection in gas phase
- H-detection in product
- H-detection in copper metal by SIMS and thermal out gassing.
- In situ detection (by others) of amorphous CuOH, as discussed in "DRAFT REPORT 2009-11-04, Comments regarding the BRITE report, SSM 2009-30, A Review of Evidence for Corrosion of Copper by Water".
- The measured hydrogen release is understandable and expected by introduction of CuOH which is likely to be more stable than Cu_2O as shown by first principle calculations.

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1) SGTE Substances Database, SSUB4, Database version: 4.1, Scientific Group Thermodata Europe (2009).