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Solar thermal Extraction of Metals from Copper Sulfides

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The use of concentrated solar power is a promising and attractive route of implementing renewable energy in large scale industrial processes. Since the eighties solar thermal production of electricity at a scale of 360 MW has proven the reliability of solar technology at moderate temperatures (around 400 ˚C). At higher concentrations of sunlight (up to 5000 times) and higher temperatures (up to 2000 ˚C) solar reactors enable energy intense chemical processes to take place. A promising process is the extraction of copper from copper sulfides under inert atmospheres in a solar reactor. The world solar insolation map shows that sunlight is abundantly available in many important copper mining districts, e.g., in Chile and Southern Africa. The growing Asian market is another region where the industrial application of a solar thermal copper extraction process is attractive. A key feature of solar thermal copper extraction is the direct decomposition of copper sulfides into the metals and elemental sulfur. At the high temperatures prevailing in a solar reactor, sulfur is present as a gas and naturally separates from the liquid metals and subsequently can be collected by condensation. In conventional copper extraction processes sulfur is produced as sulfur dioxide (SO_2), which is toxic and harmful to the environment. To deal with polluting emissions SO_2 is converted to sulfuric acid. However, nowadays this solution is threatened by the saturation of the sulfuric acid market. The solar approach offers a more elegant solution as it works in the absence of oxygen and therefore prevents the formation of SO_2. Furthermore, high operating temperatures promote the removal of unwanted impurities such as heavy metals. Decomposition experiments on synthetic copper iron sulfides in an imaging furnace showed that above 2000 K copper is formed within minutes. These experiments also provided the parameters for preliminary calculations of energy demand. They indicate that at places with high solar irradiation a daily production of 100 to 150 tons of copper can be envisioned with plant sizes as

they are also expected for other solar chemical processes. Since the solar process does not need a sulfuric acid plant and oxygen plant, we expect that solar copper can be produced at competitive costs.