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Bioreduction of precious metal ions Au (III) and Ag (I) using *Geobacter sulfurreducens*

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Gold mining industries produce residues such as aqueous waste, waste rock and tailings, which may contain unrecovered gold in relatively low abundances, as well as other heavy metals, toxic chemical substances such as mercury and cyanide, or even radioactive elements that can negatively influence the environment. Microorganisms can offer passive and sustainable approaches for the bioremediation of land and contaminated water. In addition, metal-reducing bacteria can convert high oxidation state precious metal ions in waste solutions, to nano-scale zero-valent metal precipitates, offering a potentially inexpensive metal recovery approach. In this study, the biorecovery of gold and silver as metallic nanoparticles using the metal-reducing bacterium *G. sulfurreducens* was investigated. Inductively coupled plasma mass spectrometry ICP-MS showed that > 96% of Au (III) and Ag (I) were reduced to zero-valent nanoparticles, with H_2 a more effective electron donor than acetate (especially for Au (III)). In addition, X-ray diffraction XRD and transmission electron microscopy TEM confirmed the formation of Au and Ag nanoparticles. These findings suggest that the use of *G. sulfurreducens* and hydrogen could be a good potential option for the biorecovery of Au and Ag from mine effluents, and this hypothesis is being tested against materials collected from Saudi mining sites.