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[P005] Poster

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[P03-299] Tuning metal reduction for biomanufacturing of gold nanoparticles

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The recovery of precious metals from electronic waste (e-waste) represents an important sustainable approach with environmental and economic benefits. Bioremediation strategies employing engineered microorganisms offer promising alternatives to conventional harsh extraction methods. This study focuses on the engineering of a metal reductase, MerA, to enhance its catalytic activity toward precious metal ions commonly found in e-waste. In this study, we report the successful engineering of MerA, whose cognate substrate is Hg (II), towards other precious metals such as Au (III) and Ag (I). Specifically, the engineered variant exhibited a 15-fold improvement in catalytic efficiency for gold ion reduction and a 200-fold enhancement for silver ion reduction with respect to the wild-type enzyme. The apparent shift in preference towards non-cognate metal ions may be attributed to the energetics of valency preference. The variant displayed an apparent shift towards preferring monovalent metal ions, such as Au (I) and Ag (I), over divalent cations such as Hg (II). The K_M for Hg (II) of the variant increased by 5-fold. These findings provide mechanistic insights into the bioreduction of Au (III) that could proceed through the stabilization of an intermediate oxidation state, Au (I), *en route* to Au (0). A preliminary study was also performed on the purified wild-type enzyme and variant to examine the effect they have on Au (III) reduction. Basic characterization of the gold nanoparticles was also performed, such as transmission electron microscopy (TEM), to explore ways to characterize the gold nanoparticles. This study advances the fundamental understanding of enzyme-mediated metal reduction mechanisms and offers potential for developing biological systems capable of the biomanufacturing of gold nanoparticles from e-waste. This direction helps to develop sustainable methods for recovering precious metals from e-waste, reducing the environmental impact of precious metal recovery processes.