Highly efficient recovery of noble metals using hemoglobin crystals through one-step process

Xiao-Qian Jin, Chen-Yuan Li, Freeha Kanwal, Da-Chuan Yin*

School of Life Sciences, Northwestern Polytechnical University, Xi’an, China.

Email of communicating author: yindc@nwpu.edu.cn

Keywords: Cross-linked hemoglobin crystals; Gold recovery; Electric wastewater

Protein crystals is a form of assembly with highly ordered protein molecules. In biology, the most commonly referred application of protein crystals is its value in determination of high-resolution 3D structure of protein molecules. However, in this study, the crosslinked hemoglobin crystals (CLHCs) prepared from chicken blood realize the green recovery of gold ions from wastewater, though adsorption and reduction to Au(III) at the same time. Under optimum conditions, the maximum adsorption capacity of hemoglobin crystal for Au(III) can reach to 123.2 mg/g, and the adsorption efficiency is almost 100%, which is significantly higher than other biological adsorbents. Furthermore, the CLHCs were characterized by TEM, XRD, FTIR, XPS, before and after adsorption. The results showed that half of the Au(III) were reduced to gold crystals through reduction, and others of Au(III) were absorbed by CLHCs through physical and chemical reaction. Moreover, when the CLHCs was used to treat the simulated electron wastewater, it showed excellent selectivity of Au(III), and the recovery efficiency reaches 99.73%.

Figure 1. Recovering gold from wastewater by CLHCs

This work was supported by National Natural Science Foundation of China (NSFC) (Grant No. 82172063), Science and Technology Program of Ali Region, Tibet (Program No. QYXTZX-AL2022-07), and the Innovation Capability Support Program of Shaanxi (Grant No. 2020TD-042).