

Biomining of Rare Earth Elements from Primary and Secondary Sources

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There is an increasing demand for rare earth elements (REEs) in renewable energy, consumer products, and defense applications. Due to the uncertainty in the global REE supply chain, there is an urgent need for the development of new technologies that enable cost-effective recovery of REEs from alternative feedstocks. To address this need, we took a biomining approach by coupling bioengineering with chemical engineering to synthesize novel biomaterials that selectively adsorb REEs. Biological ligand lanmodulin protein and its homologs were exploited for rare earth recovery. We immobilize these ligands on bacterial surfaces or other porous materials and with these immobilized biological resins, we have developed ion-exchange columns for a flow-through operation for REE separation and purification. Technology features and REE recovery performance from leachates of various REE sources will be described. Preliminary predictions on the economic viability of integrating a biosorption approach into an industrial-scale REE recovery process will be discussed. Our biomining approach leads the way for an economical, scalable, and environmentally sustainable REE recovery process, and if successful, will bring a paradigm change to the extractive hydrometallurgy.

