Nanotechnology Convergence for Materials and Resource Recovery

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Minerals and natural resources are the building blocks and pillars of a sustainable society and global economy. There is a growing realization that the implementation of the clean-energy technologies and sustainable processes, products and industries of the 21st century will require large amounts of critical metals including rare-earth elements, platinum group metals, copper, lithium, gallium, and precious metals (e.g., silver and gold). Significant amounts of phosphorus (P) will also be needed to produce fertilizers as the world faces the daunting challenge of doubling the amount of food it currently produces in order to feed around 9 billion people by 2050. As a society, our stewardship of Earth's mineral and natural resources is not sustainable; we utilize and consume large amounts of metals, P, and other materials produced by mining with little or no recycling. The convergence between nanotechnology, industrial ecology, water purification and separation science is providing unprecedented opportunities to advance the recovery of critical materials and resources from non-traditional sources including (i) impaired water (e.g., seawater, brines, and municipal/industrial wastewater) and (ii) solid wastes (e.g., discarded consumer products and sludge). In this presentation, I will give an overview of nanotechnology convergence for materials and resource recovery. I will then discuss recent advances with a focus on two areas where materials and resource recovery from impaired water and solid wastes are likely to have the greatest impact over the next decades: 1) metal recovery from industrial wastewater, seawater and discarded consumer products and 2) phosphate recovery from municipal wastewater. I will conclude my presentation by highlighting critical environmental, regulatory and market challenges that need to be addressed to advance the viability of materials and resource recovery from solution and wastes.

References

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