Contribution ID: **28** Type: **not specified**

Precious metal recovery from nanowaste for sustainable nanotechnology: Current challenges and life cycle considerations

Monday, 9 March 2015 12:50 (20 minutes)

The increasing use of nanomaterials poses new challenges for their disposal and waste management. Moreover, several nanotechnologies employ resource-limited materials, such as precious metals and rare earth elements. It is therefore essential to develop strategies to recover and recycle these materials from nanowaste, and thus make nanotechnology more sustainable. However, at present, neither well-established protocols nor federal regulations exist for nanowaste management and precious metal recovery from nanowaste. To address this issue, we developed laboratory-scale methods to recover gold from nanowaste. For our initial experiments, we used potassium tetrabromoaurate and citrate-coated gold nanoparticles (AuNPs) as simulated waste. Apha-cyclodextrin was used to recover gold via selective complexation, followed by downstream treatments to form chloroauric acid. Finally, the chloroauric acid from recovered gold was used to make new AuNPs. Besides developing new methods for recovering and recycling gold from nanowaste, we are also conducting life cycle assessment to compare the scenarios of gold production with and without recycling. Our research can provide new insights into the chemistries involved in gold recovery, as well as into the life cycle considerations in nanowaste recycling. This research also has the potential to improve current waste management practices and inform future nanowaste management policies.

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Session Classification: 1C Life Cycle Thinking & LCA

Track Classification: Parallel session 1C: Life Cycle Thinking & LCA