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Advancing the Arizona State University Knowledge Enterprise

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Single-Step Process for Production of Phenol and Copper Metal

Background

Over 10 million metric tons of phenol are produced annually, making it a commodity chemical with a multibillion-dollar market. Phenol is primarily used as an intermediate in the production of polymers and adhesives. The current industrial production method is the cumene process, a complex, multi-step process that limits yield and produces unwanted side products. It would be advantageous to produce phenol through a single reaction where benzene is the only organic reagent.

Invention Description

Researchers at Arizona State University have developed a one-pot hydrothermal synthesis of phenol from benzene with selectivity towards phenol exceeding 96%. This synthetic process oxidizes benzene with copper sulfate and turns Earth-abundant ionic copper into metallic copper. If this process is used in copper production, ionic copper can be reduced to copper metal by benzene instead of electrical input. This synthetic process is advantageously free of alkylation and does not require propene. Avoiding non-benzene organic compounds simplifies this process and eliminates the need to process or sell organic byproducts. If implemented in a copper mining setting, this process would use copper-rich water that is already available and convert it into the desired copper metal end product, all while producing a valuable commodity chemical. In this scenario, both the oxidant and the reductant undergo a transformation to a more valuable product.

Potential Applications

- Industrial phenol production
- Copper reduction

Benefits and Advantages

- Simpler than current phenol synthesis methods
- Bypasses the alkylation process and does not require a stream of propene
- Metallic copper co-product rather than acetone

- Carried out with Earth-abundant materials that are easily handled at room temperature
- Inspired by natural geological chemical processes

Faculty Profile of Professor Everett Shock

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