Superhydrophobic Coating for Evaporative Purification and Minerals Extraction

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Technology Summary

Researchers at ORNL are using their superhydrophobic coating technology to tackle the age-old problem of obtaining potable water. In the process, they have also developed a cost-effective method to extract industrial minerals and metals such as potassium, lithium, and magnesium from the seas and other waters.

Potable water is becoming an increasingly scarce resource. Evaporative desalination is one of the cheapest, easiest, simplest ways to covert salt or brackish water into fresh water. Unfortunately, huge salt deposits are created during the process. These deposits form a hard, well-bonded coating on exposed surfaces that must be regularly removed to keep the operation efficient and commercially viable. The required cleaning not only takes a lot of time, effort, and energy, but also requires large amounts of fresh water. Because of this, evaporative desalination has all but been abandoned commercially in the United States—until now.

ORNL's superhydrophobic (SH) coatings amplify a liquid's surface tension, creating a microscopic layer of air on the SH surface that inhibits water contact with the treated surface. Simple hydrophobic coatings create no such air layer and therefore don't perform as well. A drop of ocean water on an SH treated surface will ball up and roll around like a marble. As the water evaporates and crystals start to form, the crystals don't adhere to the treated surface and are easily removed. ORNL scientists have successfully demonstrated the technology with treated containers filled with ocean water. The crystals so formed also contain solidified minerals.

Applying ORNL's SH coatings to all flat, curved, tubular, and other surfaces at least partially in contact with contaminated liquids or the contaminants themselves will greatly simplify maintenance of desalination equipment and significantly reduce salt contamination and resulting corrosion of surrounding structures and support equipment. The process can also be used for extracting minerals and metals from ocean and brackish waters separate from or combined with production of potable water.

Advantages

- Environmentally friendly
- Little to no hazardous waste
- Easy to apply and scalable
- More durable than traditional superhydrophobic coatings
- Low cost

Potential Applications

- Purification of salt and brackish waters
- In-field military water purification systems
- Corrosion inhibition for desalination equipment and support structures
- Materials separation/mineral extraction
- Anti-fouling coatings

Patents

John T. Simpson, Steve R. McNeany, Thomas V. Dinsmore, Scott R. Hunter, and Ilia N Ivanov. *Superhydrophobic Coated Apparatus for Liquid Purification by Evaporative Condensation,* U.S. Patent Application 13/030,535, filed February 18, 2011.

John T. Simpson and Scott Hunter. *Harvesting Dissolved Minerals and Salts from Ocean Water,* application in preparation.

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