Polymeric Materials for Efficient Solar Vapour Generation

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Abstract:

Water has played an imperative role which directly and indirectly impacted our daily life. Up to recently, there has been a high demand for freshwater resources with a projection of 55% increase by 2050 due to the increasing population and economic growth. Over the past 100 years, water usage has increased by a factor of six and continuously grown 1% every year, supplying the demand of industrial/manufacturing, thermal power generation, agriculture, and domestic usage. Apart from increasing water usage, population and economic growth have also introduced water pollution such as rising amount of wastewater from industrial and agricultural activities. Currently, our on-going freshwater production relies on distillation/desalination systems such as thermal (multi-effect distillation, thermal vapor compression, and mechanical vapor compression), and membrane distillation (electrodialysis and reverse osmosis). However, these systems contain high running cost (e.g., labor, energy, and real estate) and produce environmentally detrimental by-products such as high concentration of brine. With the growing number of countries pledging for net-zero CO_2 emission, a new efficient and greener approach known as solar vapor generator (SVG) have recently shown to be a potential greener alternative.

By harvesting solar energy through photothermic materials (PTMs), we have developed novel SVGs composed of PTMs (such as inorganic semiconductors, and carbon-based materials) and hydrophilic polymer matrix, allowing continuous water generation with minimal energy. We found that both the morphology of the PTM and the chemical structure of polymer networks play important roles in the water transport within the hydrogel membrane as well as the evaporation performance.

Keywords: Solar vapour generation, Hydrogels, Photothermal Materials, Crosslinking