Harnessing 2D Materials and Artificial Intelligence (AI) for Breakthroughs in Atmospheric Water Harvesting for Sustainable Water Solutions

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Water vapor is abundantly available in the atmosphere, making atmospheric water harvesting (AWH) technologies a promising solution for sustainable water production. We present novel composite networks, combining 2D graphene-based nanosheets within a polymeric matrix, which demonstrate exceptional water capture capabilities, with an intake of up to 7.15 g of water per gram of sorbent. The inclusion of graphene nanosheets enables desorption through natural sunlight, raising the temperature of the material by 71 °C within 20 minutes and yielding 3.36 liters of water per kilogram of sorbent per cycle. Additionally, the potential of metal-organic frameworks (MOFs) for AWH is explored, leveraging a machine learning (ML) approach to identify top-performing MOFs for water adsorption. By analyzing their structure, framework chemistry, and operational conditions, the ML models predict water adsorption properties, facilitating the screening of approximately 100,000 MOFs. This combination of experimental and data-driven methodologies underscores the potential of AWH technologies to sustainably and efficiently harvest water from atmospheric sources, while also offering new insights into the use of advanced materials like MOFs and composite hydrogels.

References

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Figures

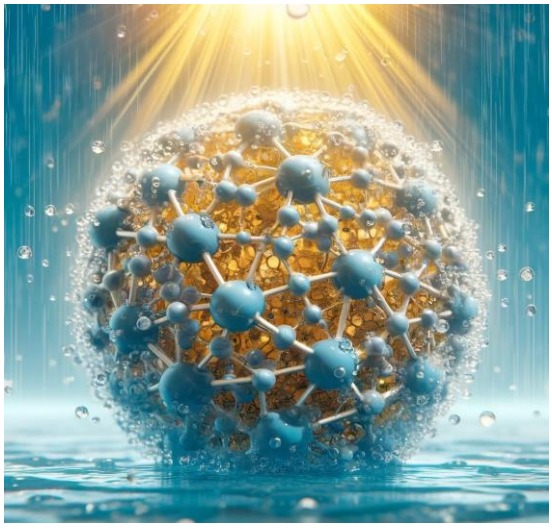

Figure 1: A novel network sorbent for AWH integrating 2D graphene-based nanosheets optimally assembled within a polymeric matrix.