Upcycling Graphene Sorbents for Organic Contaminants into High-Energy Supercapacitors

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Abstract
Pharmaceutical contamination is an increasing pressure on water systems, while sustainable treatment technologies are still lagging behind.[1] In this work, we show that functionalised graphene sorbents can efficiently remove emerging pharmaceutical pollutants from water and, importantly, can be directly upcycled after use into supercapacitor electrodes.[2]
Instead of treating spent sorbents as waste, we take advantage of their post-adsorption state. Without any additional processing, the repurposed materials outperform the original graphenes by up to 100% in full-cell devices and reach performance levels beyond current benchmarks. This improvement comes from strongly adsorbed pollutants that introduce additional redox activity and enhance charge transport, as supported by theoretical analysis.[2]
Direct upcycling of spent sorbents is still uncommon, yet it is becoming increasingly relevant in the context of sustainable materials design.[3] This approach avoids regeneration or disposal steps while creating added value, linking water treatment with energy storage in a simple and scalable way.

References

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Figures

Figure 1: After removing pharmaceuticals from water, spent graphene-based sorbents are repurposed into redox-active supercapacitor electrodes.