INVITED ORAL PRESENTATION

Natural laws for design of high performance hiererachically porous nanomaterials for energy storage and conversion

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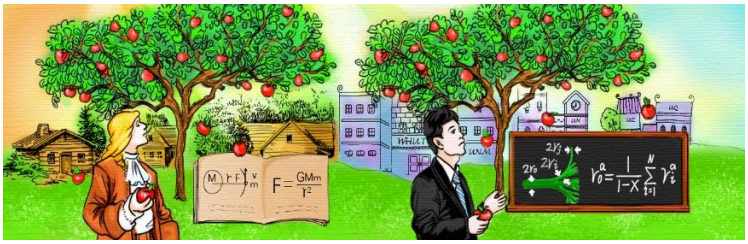
Both plants and animals possess analogous tissues containing hierarchical networks of pores, with pore size ratios that have evolved to maximize mass transport and rates of reactions. The underlying physical principles of this optimized hierarchical design are embodied in Murray's law. However, we are yet to realize the benefit of mimicking nature's Murray networks in synthetic materials due to the challenges in fabricating vascularized structures. Here we emulate optimum natural systems following our generalized Murray's law (Law of Hierarchizing). Such bio-inspired materials, whose pore sizes decrease across multiple scales and finally terminate in size-invariant units like plant stems, leaf veins and vascular and respiratory systems provide hierarchical branching and precise diameter-ratios for connecting multi-scale pores from macro to micro levels. Our Murray material mimics enable highly enhanced mass exchange and transfer in liquid-solid, gas-solid and electrochemical reactions and exhibit super performance in photocatalysis, gas sensing and as Li-ion battery electrodes.



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