273e Multiscale Materials for High-Power Biocatalytic Electrodes

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Power systems based on biological fuels must generate high electrical power density from plant-derived fuels over long periods. Biocatalyzed electrodes offer fast and robust conversion of such fuels to electricity, but because of the 10-nm size of the typical catalyst molecule, sufficiently biocatalyzed electrodes tend to exceed 100 μm in thickness, introducing transport limitations, not only for reactants and products, but for electron transfer to and from the biocatalyst via mediator species. Adding nanometer-scale carbon structures to the micron-scale carbon cloth offers significant potential improvement in electrode performance by increasing the surface area by up to three orders of magnitude, without sacrificing structural strength or limiting reactant mass transfer. Studies of direct growth of carbon nanotubes onto carbon fiber for glucose-oxidizing bioanodes have demonstrated increased catalytic activity by factors of four over bare carbon paper.