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Design of Catalytic Nanomotors by Dynamic Shadowing Growth[1]

JOHN GIBBS, YIPING ZHAO, University of Georgia — Catalytic nanomotors are inorganic replicas of cellular motor proteins that convert chemical energy into work for mobility. These nanostructures achieve self-propelled mobility by carrying an on-board catalyst releasing stored chemical energy. Many researchers use template-directed electroplating (TDEP) which allows simple geometries such as cylindrical rod structures. We use a different method combining physical vapor deposition with dynamic shadowing growth (DSG) to fabricate artificial catalytic nanomotors. DSG allows for the construction of a wide range of structures and the asymmetric deposition of the catalyst layer necessary for nanomotor propulsion. We have constructed a multi-component rotary structure consisting of a silica microbead with a long arm attached, and the motion can be tuned by depositing the catalyst on different locations. We also have studied the propulsion mechanism associated nanomotor movement. The catalytic reaction most often studied is the break-down of hydrogen peroxide into water and oxygen gas. We have observed that the structures are propelled away from the catalyst, and we have developed a bubble propulsion model using a spherical microbead half-coated with Pt. Our model suggests propulsion arises by the release and ejection of oxygen. We predict a dependence upon the concentration of hydrogen peroxide as well as surface tension of the solution fitting empirical evidence.

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