MIT Chemical Engineering Department

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The Bionic Microbe: Electronic upgrades to biology for semi-artificial photosynthesis

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4:15pm, refreshments at 4:00pm

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Abstract:

As the Age of Oil wanes, petrochemical routes to produce food, fuels, fertilizers, materials, pharmaceuticals, and every other chemical under the sun require replacements. Combining the high solar energy efficiency of inorganic semiconductors with the vast biosynthetic repertoire of microorganisms offers a way to surpass the performance of purely biotic or purely abiotic synthetic routes, provided that we can navigate the seamless integration of the hard world of chemistry with the seemingly incompatible soft world of biology. In our first approach at this interface, we've explore newly designed/discovered "cyborg bacteria": CO_2-fixing microbes that biosynthesize semiconductor nanoparticles to self-photosensitize, enabling photosynthesis of food, fuels, polymers and pharmaceuticals at efficiencies that surpass those of natural photosynthesis. In our most recent approach, we look to the "bionic leaf": a bioelectrochemical reactor that cultivates a wide range of wild-type and engineered microorganisms at 10× the solar-to-biomass efficiency of plants. Cultivation of N_2-fixing, plant-beneficial soil bacteria in the bionic leaf produces a potent living biofertilizer derived from solar energy, air, and water to meet the needs of high-yielding modern sustainable agriculture.