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Toward on-chip directed evolution of unicellular organisms for efficient hydrogen production[1] DAVID LIAO, CALEB HOWE, CECILIA MULDOON, PETER GALAJDA, JUAN KEYMER, ROBERT AUSTIN, Princeton University — To provide an energy resource alternative to fossil fuels, photosynthetic organisms must increase their energy conversion efficiency. The green algae *C. reinhardtii* stores light energy in hydrogen gas at 0.1% efficiency, less than the 10% required to compete with established fuels. This work combines hydrogen sensing in liquid culture with micro habitat patch (MHP) chips for directing hydrogen-producing organisms to evolve improved energy conversion efficiency. A MHP chip contains 87 1 mm $\times$ 1 mm $\times$ 100 μm interconnected chambers. By measuring hydrogen output from different chambers, we will select less productive patches to annihilate. We microfabricated chips from poly(dimethylsiloxane). Color changes in fluorescence micrographs confirm that 254 nm radiation kills algae in MHPs, liberating nutrients and space for exploitation by adjacent populations. We demonstrated colorimetric detection of hydrogen gas production at a rate of 10^{-8} mol H_2 mL^{-1} s^{-1} using tungsten film on sub-mL liquid cultures of *C. reinhardtii* during 2-hrs. of fermentation in darkness.

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