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Photothermally Evoked Proton-selective Currents

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Artificial strategies for light-controlled regulation of selective ion transport enable precise manipulation of cellular excitability. All-chemical approaches offer an exciting alternative that is independent of cellular protein machinery and exogenous light-sensitive channels. Previous efforts to regulate ion transport through membrane heating have employed silicon nanowires, fuzzy graphene, and near-infrared (NIR) lasers. Here, we introduce a novel approach using a lipidated protonophore that also functions as a photothermal absorber when illuminated with red light. The resulting membrane heating leads to a remarkable 20- to 50-fold increase in proton permeability. Using reductionist model systems, we demonstrate that this mechanism operates independently of membrane channels. The robust on–off control of proton transport highlights the potential of photothermal, carrier-mediated ion transport regulation in both biological and synthetic cells