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Light-effect transistor (LET) with multiple independent gating controls for optical logic gates and optical amplification JASON MARMON, UNC-Charlotte, SATISH RAI, KAI WANG, WEILIE ZHOU, University of New Orleans, YONG ZHANG, UNC-Charlotte — The pathway for CMOS technology beyond the 5-nm technology node remains unclear for both physical and technological reasons. A new transistor paradigm is required. A LET (Marmon et. al., Front. Phys. 2016, 4, No. 8) offers electronic-optical hybridization at the component level, and is capable of continuing Moore's law to the quantum scale. A LET overcomes a FET's fabrication complexity, e.g., physical gate and doping, by employing optical gating and photoconductivity, while multiple independent, optical gates readily realize unique functionalities. We report LET device characteristics and novel digital and analog applications, such as optical logic gates and optical amplification. Prototype CdSe-nanowire-based LETs, incorporating an M-S-M structure, show output and transfer characteristics resembling advanced FETs, e.g., on/off ratios up to 10^6 with a source-drain voltage of 1.43V, gate-power of 260nW, and a subthreshold swing of 0.3nW/decade (excluding losses). A LET has potential for high-switching (THz) speeds and extremely low-switching energies (aJ) in the ballistic transport region. Our work offers new electronic-optical integration strategies for high speed and low energy computing approaches, which could potentially be extended to other materials and devices.

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