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Geometry Induced Optimization of Energy Consumption in an Ultrafast Metamaterial Modulator ATISH AGARWALA, Swarthmore College, Swarthmore, PA and Femtosecond Spectroscopy Unit, Okinawa Institute of Science and Technology, Okinawa, Japan, KESHAV DANI, Femtosecond Spectroscopy Unit, Okinawa Institute of Science and Technology, Okinawa, Japan — We investigate the energy consumption per bit of an all-optical ultrafast metmaterial modulator via improvements in the geometric design of the device. The device is a 100nm thick tri-layered Ag-Si-Ag fishnet structure metamaterial with a negative index resonance in the NIR. Previously, the device has been shown to be capable of terabit per second all-optical modulation requiring 3nJ/bit of energy. In this talk, we study different device geometries including stacked fishnet structures and variations in sidewall angles in order to reduce the energy consumption required to switch a single bit. Our simulations indicate an optimized structure that allows us to reduce our energy requirement to only 25pJ/bit for a device integrated with an optical fiber. Such improvements in energy consumption are essential for future practical devices allowing for terabit per second all-optical communication. They also provide insight into future energy-efficient metamaterial photonic devices.

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