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Title:Electronically reconfigurable metal-on-silicon metamaterial

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Abstract:Reconfigurable metamaterial-based apertures can play a unique role in both imaging and in beam-forming applications, where current technology relies mostly on the fabrication and integration of large detector or antenna arrays. Here, we report the experimental demonstration of a voltage-controlled, silicon-based electromagnetic metamaterial operating in the W-band (75-110 GHz). In this composite semiconductor metamaterial, patterned gold metamaterial elements serve both to manage electromagnetic wave propagation while simultaneously acting as electrical Schottky contacts that control the local conductivity of the semiconductor substrate. The active device layers consist of a patterned metal on a 2- μ m-thick n-doped silicon layer, adhesively bonded to a transparent Pyrex wafer. The transmittance of the composite metamaterial can be modulated over a given frequency band as a function of bias voltage. We demonstrate a quantitative understanding of the composite device through the application of numerical approaches that simultaneously treat the semiconductor junction physics as well as wave propagation.

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