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A nanoscale Inverse-Extraordianry Optoconductance (I-EOC) efficient room temperature photodetector[1] A.K.M. NEWAZ[2], L.C. EDGE, K.D. WALLACE, M.S. HUGHES, S.A. WICKLINE, S.A. SOLIN, Washington University in St. Louis, A.M. GILBERTSON, L.F. COHEN, Imperial College London, W.-J. CHANG, R. BASHIR, University of Illinois at Urbana-Champaign — We present here a new nanoscale efficient photon sensor based on a new form of extraordinary optoconductance phenomenon, (EOC), in nanoscopic metal-semiconductor hybrid structures (MSH) at room temperature. Our macroscopic devices (dimension > 500 nm) exhibit a normal EOC in which the effective resistance decreases with increased illumination intensity, whereas nanoscopic structures (dimension < 500 nm) of the same geometric design exhibit an inverse and much larger response in which the effective resistance increases with illumination intensity. This inverse EOC (I-EOC) effect is driven by the cross-over from ballistic to diffusive transport of the photo-induced carriers. We observe at room temperature a maximum I-EOC of 9460% for a 250 nm device under 633 nm illumination corresponding to a specific detectivity of $D^* = 3.2 \times 10^{11}$ cmHz$^{1/2}$/W with a dynamic response of 40 dB making this sensor technologically competitive for a wide range of nanophotonic applications.

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[2]Present Address: Michigan State University

A.K.M. Newaz
Washington University in St. Louis

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