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Two-dimensional materials based transparent flexible electronics[1]

LILI YU, SUNGJAE HA, DINA EL-DAMAK, ELAINE MCVAY, XI LING, ANANTHA CHANDRAKASAN, JING KONG, TOMAS PALACIOS, MIT — Two-dimensional (2D) materials have generated great interest recently as a set of tools for electronics, as these materials can push electronics beyond traditional boundaries. These materials and their heterostructures offer excellent mechanical flexibility, optical transparency, and favorable transport properties for realizing electronic, sensing, and optical systems on arbitrary surfaces. These thin, lightweight, bendable, highly rugged and low-power devices may bring dramatic changes in information processing, communications and human-electronic interaction. In this report, for the first time, we demonstrate two complex transparent flexible systems based on molybdenum disulfide (MoS_2) grown by chemical vapor method: a transparent active-matrix organic light-emitting diode (AMOLED) display and a MoS_2 wireless link for sensor nodes. The 1/2 x 1/2 square inch, 4 x 5 pixels AMOLED structures are built on transparent substrates, containing MoS_2 back plane circuit and OLEDs integrated on top of it. The back plane circuit turns on and off the individual pixel with two MoS_2 transistors and a capacitor. The device is designed and fabricated based on SPICE simulation to achieve desired DC and transient performance. We have also demonstrated a MoS_2 wireless self-powered sensor node. The system consists of as energy harvester, rectifier, sensor node and logic units. AC signals from the environment, such as near-field wireless power transfer, piezoelectric film and RF signal, are harvested, then rectified into DC signal by a MoS_2 diode.

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