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DNA base-specific modulation of μA transverse edge currents through a metallic graphene nanoribbon with a nanopore KAMAL K. SAHA, Department of Physics and Astronomy, University of Delaware, Newark, DE 19716, MARIJA DRNDIĆ, Department of Physics and Astronomy, University of Pennsylvania, Philadelphia, PA 19104, BRANISLAV K. NIKOLIĆ, Department of Physics and Astronomy, University of Delaware, Newark, DE 19716 — We study two-terminal devices for DNA sequencing which consist of a zigzag graphene nanoribbon (ZGNR) and a nanopore in its interior through which the DNA molecule is translocated. Using the nonequilibrium Green functions combined with density functional theory, we demonstrate that each of the four DNA nucleobases inserted into the nanopore, whose edge carbon atoms are passivated by either hydrogen or nitrogen, will lead to a unique change in the device conductance. Unlike other recent biosensors based on transverse electronic transport through translocated DNA, which utilize small (of the order of pA) tunneling current across a nanogap or a nanopore yielding a poor signal-to-noise ratio, our device concept relies on the fact that in ZGNRs local current density is peaked around the edges so that drilling a nanopore away from the edges will not diminish the conductance. Inserting a nucleobase into the nanopore affects the charge density in the surrounding area, thereby modulating edge conduction currents whose magnitude is of the order of μA at bias voltage $\simeq$ 0.1 V. The proposed biosensors could also be realized with other nanowires supporting transverse edge currents, such as chiral GNRs or wires made of two-dimensional topological insulators.

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