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Sheared graphene: Electronic properties shaped by a mechanical instability[1] ANDRES CONCHA, School of Engineering and Sciences, Adolfo Ibañez University, Santiago, Chile., SHENGFENG CHENG, Department of Physics, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061, USA, LUCIAN COVACI, Department Fysica, Universiteit Antwerpen, Groenenborgerlaan 171, B-2020 Antwerpen, Belgium, L. MAHADEVAN, School of Engineering and Applied Sciences, Harvard University, Cambridge, MA 02138,USA. —
We explore the effects of shearing graphene ribbons on its geometry, and electronic properties. Inspired by macroscopic experiments, we show that spontaneous patterns appear when a wide ribbon is subject to shear. We compared this pattern and different regimes obtained via MD simulations with macroscopic experiments, and find good agreement between them. Beyond the low shear regime a second generation of wrinkles emerge when the system relaxes trying to keep the bond lengths as close to the relaxed length as possible. Remarkably, for all shear ratios the induced superlattice generates a momentum kick when electronic excitations enter the deformed region, an effective pseudo-magnetic superlattice, and a strong Fermi velocity renormalization. These effects modify electronic properties and suggest a simple route to engineer electronic waveguides and switches at the nanoscale. Our proposal is a concrete realization of a quantum device that takes full advantage of an elastic instability that spans from the nano to macro−scales.

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