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Straining graphene with low-temperature compatible electrostatic comb-drive actuators TYMOFIY KHODKOV, MATTHIAS GOLDSCHE, JARA-FIT and II. Institute of Physics A, RWTH Aachen, SVEN REICHARDT, II. Institute of Physics A, RWTH Aachen, CHRISTOPH STAMPFER, JARA-FIT and II. Institute of Physics A, RWTH Aachen — Graphene holds great promises as an active element in future nano electromechanical systems. Therefore, thorough study of electromechanical properties of this 2D material is a crucial step towards its applications in flexible electronics. We present the fabrication and characterization of silicon-based electrostatic comb-drive actuators made for integrating individual graphene sheets. The micromachined comb-drive actuators are designed such that they can induce significant mechanical forces for straining graphene allowing to systematically investigate mechanical and electromechanical properties of high-quality graphene. By using highly doped silicon the comb-drive actuators become compatible with low temperatures, i.e. cryogenic temperatures allowing for quantum electromechanical experiments. Further device functionality is introduced by a local gate that enables the tunability of the chemical potential of the graphene. This approach makes possible a detailed study of the graphene under controlled high strain allowing simultaneous and independent tuning of other external parameters, i.e temperature, charge density, magnetic field. With Raman spectroscopy we measure and characterize mono and bilayer graphene samples at room temperature under applied strains up to 1%. A detailed analysis of data allows clear separation of strain and doping. It is demonstrated that with this technique graphene sheet reproducibly experiences only strain while operating the comb-drive actuator.

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