

Abstract Submitted  
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**Electronic Strengthening of Graphene by Charge Doping**<sup>1</sup> CHEN SI, Tsinghua University, University of Utah, ZHENG LIU, University of Utah, WENHUI DUAN, Tsinghua University, FENG LIU, University of Utah — Graphene is known as the strongest 2D material in nature, yet we show that moderate charge doping of either electrons or holes can further enhance its ideal strength by up to  $\sim 17\%$ , based on first principles calculations. This unusual electronic enhancement, versus conventional structural enhancement, of material's strength is achieved by an intriguing physical mechanism of charge doping counteracting on strain induced enhancement of Kohn anomaly, which leads to an overall stiffening of zone boundary  $K_1$  phonon mode whose softening under strain is responsible for graphene failure. Electrons and holes work in the same way due to the high electron-hole symmetry around the Dirac point of graphene, while over doping may weaken the graphene by softening other phonon modes. Our findings uncover another fascinating property of graphene with broad implications in graphene-based electromechanical devices.

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