Hybrid nanomechanical systems are promising candidates for quantum computation and quantum information. Semiconducting carbon nanotubes (CNTs) are appropriate for nanomechanical resonators for their outstanding physical and electrical properties. In the coupled systems of single electron spins and mechanical motions in suspended CNTs, the spin-phonon coupling is caused by the inherent curvature-induced spin-orbit interaction and the spatial change of the direction of the nanotube axis.

Based on the spin-phonon coupling, we theoretically investigate the nanomechanical manipulation of single electron spins which requires off-resonant external electric driving fields [1,2], the nanomechanical readout of single spins by measuring the vibrational amplitude of the CNT through a nearby charge sensor [3], and the creation of arbitrary quantum acoustic states by transferring information from the spin state to the mechanical motion [4].