Carbon nanotubes, graphene, and diamond hold an important role in the exploration of new physics and applications at the nanoscale. As a result of their strength, large surface-to-volume ratio, and small physical size, carbon nanotubes and graphene have enabled the study of new regimes in nanoelectromechanical systems (NEMS). Also, single spins associated with the nitrogen-vacancy defect in diamond are opening pathways toward room-temperature quantum information processing and nanometer-scale sensing. Here, I discuss specific uses of carbon nanotube and graphene NEMS to improve the resolution of scanning probe microscopy and to study novel non-linear dynamics that emerge in NEMS. Furthermore, I will describe the engineering and use of optically trapped nanodiamonds as an approach to three-dimensional spin-based scanning probe magnetometry and thermometry in fluids.