

Binary Spiky/Spherical Nanoparticle Films with Hierarchical Micro/Nanostructures for High-Performance Flexible Pressure Sensors

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Recently, flexible pressure sensors have been widely explored in high technology industries such as electronic skins, wearable devices. For use in these applications, there are still challenges in high sensitivity, linearity, and simple fabrication process. Herein, we demonstrated a highly flexible and sensitive pressure sensor based on a bimodal conductive nanoparticles system (spiky/spherical shapes) fabricated by a simple spray coating process. The two different shapes of nanoparticles are based on the core-shell structure of spherical silica nanoparticles decorated with polyaniline conductive shells. To enhance the pressure sensing performances, we manipulated multilevel nano/micro hierarchical structures of pressure-sensitive films by control the ratio of particles. Consequently, our sensor shows high sensitivity (17.5 kPa^{-1}) and linear responsivity over a wide pressure range (0.008–120 kPa), owing to the effective stress distribution and gradual deformation of the multilevel hierarchical porous structure. The sensor exhibits outstanding stability over 6,000 repeated cycles with a fast response time (90 ms), and practical applicability in wearable devices.