An Improved Model to Design the Suspended Graphene Pressure Sensor for Condition Monitoring

Peng Yang[1], Kehong Lv[1], Guanjun Liu[2]

[1]College of Intelligence Science and Technology, National University of Defense Technology, China,
[1]Science and Technology on Integrated Logistics Support Laboratory, National University of Defense Technology, China

Graphene has broad application prospects in the field of pressure sensing due to its extremely high Young's modulus and ultra-thin thickness, and it is expected to achieve high-performance pressure detection. The existing suspended graphene pressure sensors mostly adopt the structure with sealed cavity. However, the influence of cavity volume change is not taken into consideration in the traditional piezoresistive effect model, which leads to a larger error of the model and the lack of the effective guidance of cavity depth design. In order to guide the cavity depth design of graphene pressure sensor, this paper considers the cavity volume change caused by the graphene strain, and improves the traditional piezoresistive effect model. The traditional model and the improved model are compared, and the pressure-resistance characteristics of graphene pressure sensors under different cavity depths are quantitatively analyzed. The results show that the error of the traditional model relative to the improved model increases with the decrease of the cavity depth. When the pressure difference between the two sides of the graphene is 100 kPa and the cavity depth is 0.1 times the diameter of the cavity, the resistance change rate of the graphene film obtained by the improved model and the conventional model is 0.8% and 0.67%, respectively. The error of the traditional model compared to the improved model reached 16.3%. By comparing the pressure-resistance curves at different cavity depths of the improved model, it is shown that the sensitivity of the sensor increases with deeper cavity. Therefore, the improved piezoresistive effect model improves the accuracy of the model and can effectively guide the structural size design of the suspended graphene pressure sensor for condition monitoring.