Next-Generation Thermal Care: Flexible Graphene-Based Infant Warmers for NICUs

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Abstract

Flexible electrothermal heaters have attracted significant attention due to their wide range of applications in wearable electronics, including heated clothing for medical care devices and automotive applications [1-3]. A graphene-based flexible heating pad has been developed for medical beds in newborn care. The pad was fabricated using a graphene-polymer composite-based coating featuring uniformly dispersed graphene nanosheets. This pad delivers a lightweight, electrically conductive, highly flexible heating layer. The heating pad operates by Joule heating effect, which creates constant warmth when current flows between two electrodes, and the applied voltage enables precise temperature control. Specifically, the coating homogeneity prevents localized hot spots, minimizing the risk of thermal injury to the newborn's skin. The heating pad was designed to conform seamlessly to bed surfaces, ensuring efficient heat transfer, comfort, patient safety, and durability under repeated use and cleaning. The prepared prototype can reach 35-40°C within 5 minutes, and the pad temperature can be adjusted by the input power. Furthermore, the heating pad was examined for multiple bending cycles, passing more than one thousand cycles without any crack formation in the coating and with negligible resistance changes. Its cost-effective production enables easy integration into hospital systems. Compared to conventional metal wire-based heaters, the present graphene-polymer composite pad offers superior safety and reliable performance.

References

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Figures

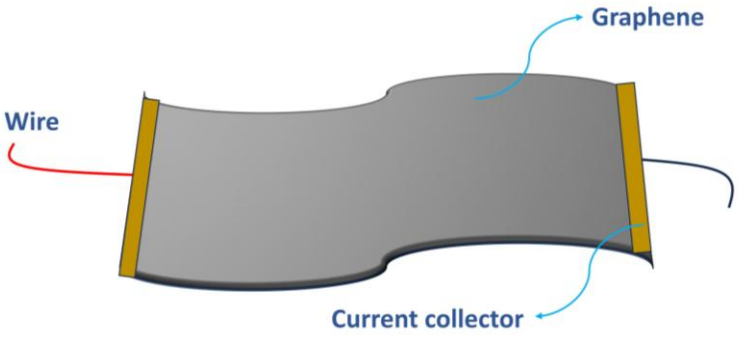

Figure 1: Schematic representation of a graphene based warmer