Microheater: material, design, fabrication, temperature control, and applications—a role in COVID-19

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ABSTRACT

Heating plays a vital role in science, engineering, mining, and space, where heating can be achieved via electrical, induction, infrared, or microwave radiation. For fast switching and continuous applications, hotplate or Peltier elements can be employed. However, due to bulkiness, they are ineffective for portable applications or operation at remote locations. Miniaturization of heaters reduces power consumption and bulkiness, enhances the thermal response, and integrates with several sensors or microfluidic chips. The microheater has a thickness of ~ 100 nm to ~ 100 µm and offers a temperature range up to 1900℃ with precise control. In recent years, due to the escalating demand for flexible electronics, thin-film microheaters have emerged as an imperative research area. This review provides an overview of recent advancements in microheater as well as analyses different microheater designs, materials, fabrication, and temperature control. In addition, the applications of microheaters in gas sensing, biological, and electrical and mechanical sectors are emphasized. Moreover, the maximum temperature, voltage, power consumption, response time, and heating rate of each microheater are tabulated. Finally, we addressed the specific key considerations for designing and fabricating a microheater as well as the importance of microheater integration in COVID-19 diagnostic kits. This review thereby provides general guidelines to researchers to integrate microheater in micro-electromechanical systems (MEMS), which may pave the way for developing rapid and large-scale SARS-CoV-2 diagnostic kits in resource-constrained clinical or home-based environments.

KEYWORDS

Gas sensor; Heater; Micro hot plate; Microheater; Temperature control; Thin-film heater

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