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ABSTRACT

Bulk-like MoS_2 Thin Films for Microfluidic Channels and High Thermoelectric Performance

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Using a standard semiconductor fabrication process, we patterned micron-scale grooves on a silicon substrate to form microfluidic channels. We then deposited tens-of-nanometers-thick MoS_2 films onto these channels following the sulfurization technique described earlier. Comparative heat dissipation tests revealed that the MoS_2-coated microfluidic system removed more heat under identical flow conditions than its pure-silicon counterpart, primarily due to MoS_2's favorable thermal transport pathways, stable interface with the working fluid, and relatively low surface energy that enhances flow velocity and improves heat removal efficiency [1]. Additionally, MoS_2 films grown on sapphire substrates were measured to have an outstanding Seebeck coefficient of 643 μV/K. This value, achieved at a thickness of approximately 7 nm, underscores the material's balanced combination of low thermal conductivity and adequate carrier density. The result signifies MoS_2's strong potential for applications in thermal management and energy harvesting, particularly when integrated into microfluidic systems.

[1] T.-S. Ko, Y.-L. Chen, J. Shieh, S.-H. Chen, J.-Y. Syu, and G.-L. Chen, J. Vac. Sci. Technol. A 41, 033106 (2023).