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Temperature sensing and real-time two-dimensional mapping at the micro-scale XIAOYE HUO, GANG LI, ZHENHAI WANG, XINYU MAO, SHENGYONG XU, Key Laboratory for Physics and Chemistry of Nanodevices, Department of Electronics, Peking University — To sense temperature at micro/nano scales and obtain its detailed distribution in space and in time remains a technical challenge in many cases. We observed an unexpected thermoelectric size effect, where the absolute Seebeck coefficient of metallic thin film stripes (e.g. Ni, Cr, Pd, W, Bi, Sc, etc.) decreased with the stripe width from 100μm down to 100nm. This phenomenon was utilized in micro/nano-stripe-based thin film temperature sensors. By using an array of such sensors, two-dimensional temperature distribution at the micro-scale could be precisely mapped. Small temperature sensors with a total width less than 1μm and a sensitivity of 0.5-2.2μV/K were fabricated, showing a potential for monitoring temperatures at submicro-scales. By using a special multiplexer and software, nearly real-time 2D temperature mapping was performed, demonstrating 2D thermal history of target surface with a delay of less than one minute. These thin film sensors were also fabricated on flexible Parylene-C substrates for application in flexible electronic devices, temperature monitoring of cell culturing, and heat transfer between Au nanoparticles and metallic stripes due to plasmonic excitation under laser radiation.

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