



Optica Applicata 2009(Vol.39), No.4, pp. 681-690

Mixed thick/thin-film thermocouples for thermoelectric microgenerators and laser power sensor

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Keywords

thick-film, thin-film, thermoelectricity, microgenerator, sensor, thermocouple, thermopile

Abstract

This work presents the fabrication of thermopiles with high output voltage. A series of mixed thick/thin-film thermopiles were performed - one of the arms of the thermocouples was screen-printed (PdAg- or Ag-based thick-film layers), the second was made of magnetron sputtered semiconductor (compositions based on Ge). The output parameters (thermoelectric force E_T [V], internal resistance R_i [Ω], output electrical power P_{out} [W]) of the structures were characterized using a self-made automatic measurement system. The best parameters were achieved for TSG/PdAg (TSG - Ge doped by Sb and Ta) and WSG/Ag (WSG - Ge doped by Sb and W) structures. Generated output voltage per single thermocouple was about 20 mV and output electrical power - 0.55 μ W, when temperature difference between hot and cold end was 100 K. Also, the influence of activation process on output parameters was investigated (structures were put into high temperature to initialize recrystallization and grain growth process). The possibilities of using of such structures as thermoelectric microgenerators or sensors were considered. TSG/PdAg-based structures were used to prepare laser power sensor. The level of generated thermoelectric force E_T was proportional to the power of the laser beam under investigation. Tests of prototype structures showed that thermoelectric sensors have sufficient resolution and ensure very good repeatability of measurements.



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