Carbon nanotube yarn based thermal sensor for measuring acceleration and tilting

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Thermal convection-based sensors have attracted attention and have been intensively studied due to their high shock reliability since they have no proof-mass and their simple fabrication process, which induces a lower cost.
It is mainly comprised of a heater and temperature sensors used to generate thermal convection and to measure the resultant temperature change due to external forces, respectively. The principal sensing mechanism of this sensor is in its non-symmetrically distributed heated air medium around its microheater when it experiences changes in external force. This means that it can withstand much higher shock than conventional sensors using a proof mass. [1]
After the first report, studies on thermal convection-based sensors have been mainly concentrated on optimizing the structural designs, pressure, and type of medium inside the chamber, whereas there is a lack of research on materials for a heater or thermal detector at present. For example, the performance of this type of sensor is highly dependent on many variables such as the size of the chamber, input power, type of gas medium, pressure, and ambient temperature. [2]
However, the consideration of materials for the heater and thermal detector is less influenced by the other design parameters, allowing the performance of the sensor to be readily improved without changing the structural design and parameters.
Here, a thermal convection-based sensor using CNT yarn is presented along with a simple and easy fabrication method. This sensor can be applied to both acceleration and tilting measurements without the modification of structure. The experiment results show a linear and stable sensitivity with low power consumption as shown Fig. 1.

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[1] D. Randjelovic et al., Sens. Actuators A **141**, 404 (2008).
[2] J.C. Choi et al., Jpn. J. Appl. Phys. **49**, 06GN15 (2010).

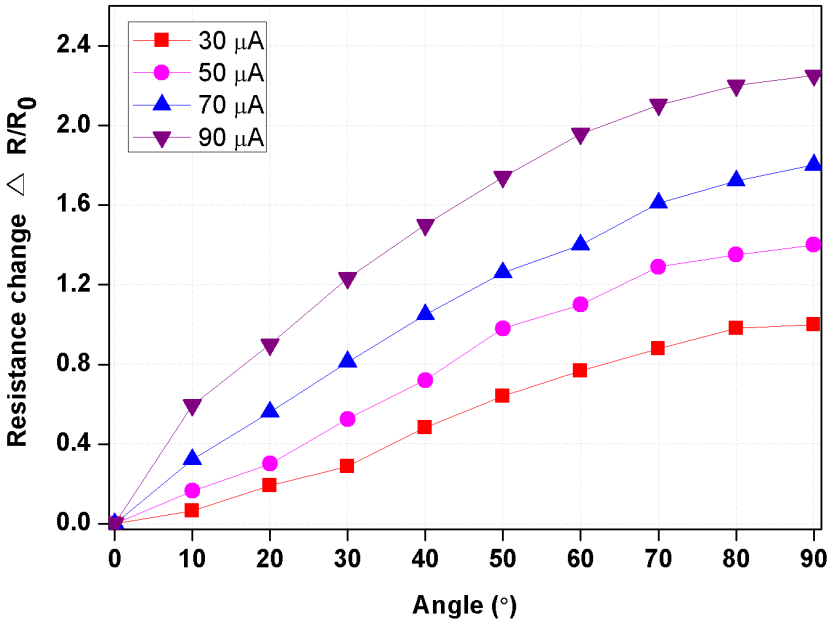

Figure 1: Output characteristic of the proposed sensor as a function of heater currents.