Research (What is it about?)	**Strain and bending sensors**
UNN authors	*Alaferdov A.V.*
We find (The result)	Highly effective strain and bending sensors based on high aspect ratio ***graphite nanobelts*** were constructed
Abstract	Various conductive nanomaterials (metal nanoparticles or nanowires, thin metal films, films composed of carbon nanotubes and grapheme sheets, carbon grease or carbon black based films) are currently being actively explored for applications in resistive strain sensors for wearable electronics. These materials can be used in the form of thin films (conductive networks) deposited over polymeric substrates or as fillers in polymer based composites. When strain is applied to a stretchable substrate, this is detected by changes in the electrical resistance of a 2D or 3D conductive network formed by the nanomaterial. The lowest power consumption required for reliable detection of strain is about 10 µW for films of metal nanowires down to 10 nW for multi-layer graphene films. The number of strain–release cycles is relatively small, usually not exceeding 100 rarely up to 1000 cycles with reasonable stability. We present here a reliable, simple, and scalable method for the fabrication of strain and bending sensors with extremely low power consumption based on thin graphite nanobelt films high aspect ratio (length/thickness ~ 10^3) deposited onto flexible polydimethylsiloxane substrates. The excellent electrical and mechanical properties of the graphite nanobelts allowed the fabrication of thin (tens of nanometers) and flexible yet highly conductive films (a resistivity about 1 kΩ sq.). These samples, tested as strain sensors (current changes as a function of applied strain), proved to be highly sensitive and robust, withstanding more than 5000 deformation–release cycles. The power consumption of the sensors can be as low as 1 nW. The device maximum stretchability is limited by the metal electrodes and the polymer substrate; the maximum strain the polymer used in this work could withstand was 40%. The sensing mechanism is based on the changes of contact area between individual nanobelts under strain and bending. Bending tests carried out for various radius of curvature demonstrated distinct sensor responses for positive and negative curvatures.

Representative articles 2016-2017, quartiles	1. *Alaferdov A.V., Savu, R., Rackauskas T.A., Rackauskas, S., Canesqui M.A., de Lara D.S., Setti G.O., Joanni E., de Trindade G.M., Lima U.B., de Souza A.S., Moshkalev S.A.* A wearable, highly stable, strain and bending sensor based on high aspect ratio graphite nanobelts. Nanotechnology. **27**: 375501 (2016).	Q1, Q1,Q2
	Q-index (Qi) of the result	**3.67**

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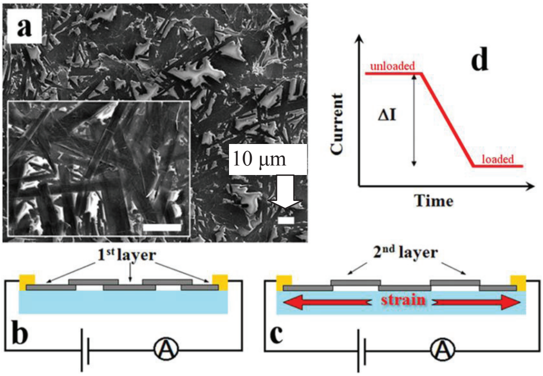
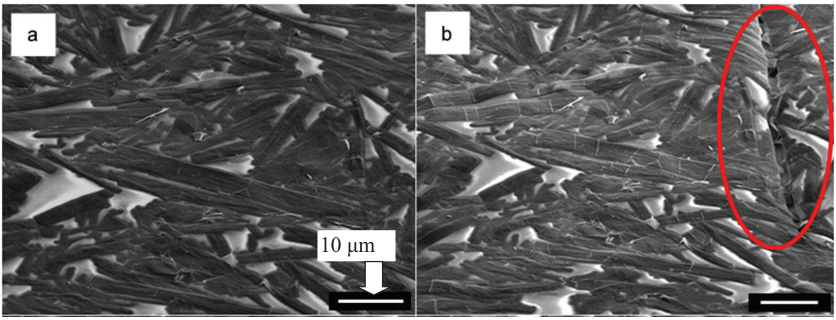
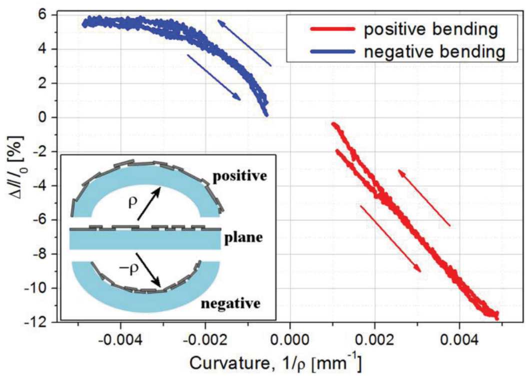


(a) substrate covered with percolated nanobelts. Schematic illustrations of the strain sensing mechanism: initial unloaded state (b), loaded state with reduced contact areas between nanobelts (c), and evolution of electrical current during deformation cycle (d).



Nanobelt film deposited on the polydimethylsiloxane substrate, before (a) and after (b), being submitted to high deformation (~50% strain). The red ellipses indicate the regions where cracks occur with the first layer nanobelts cracking together with the polymer substrate.



Sensor response to positive and negative bending; arrows show the direction of curvature changes. The inset shows a schematic drawing of the sensor in its original state and submitted to positive or negative bending.