


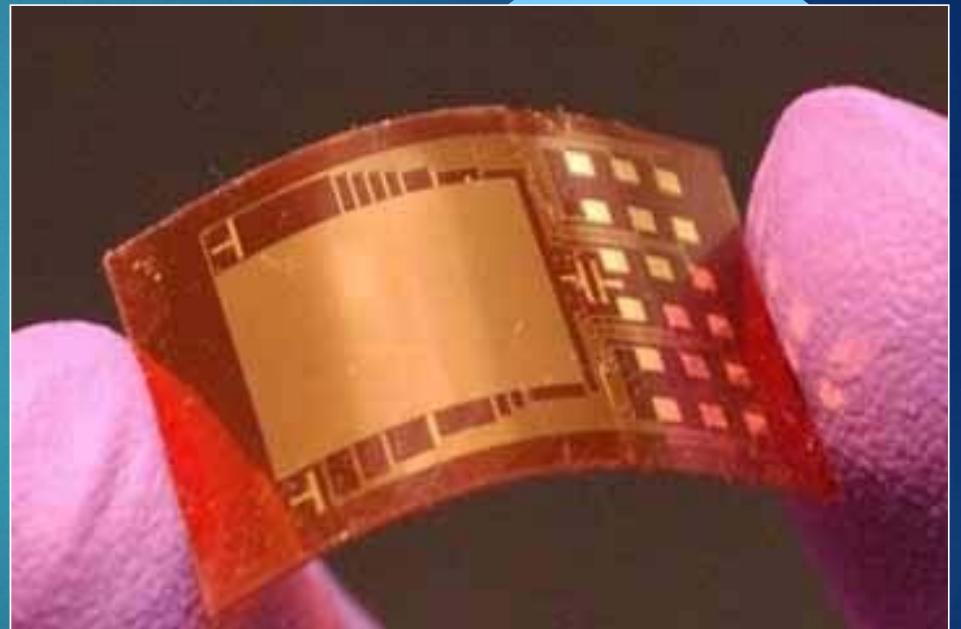
Harvesting Mechanical Energy with Nanogenerators

A large, light blue circle is positioned on the right side of the slide, partially overlapping the text 'Mechanical Energy' and 'Nanogenerators'.

KAILANI REDDING

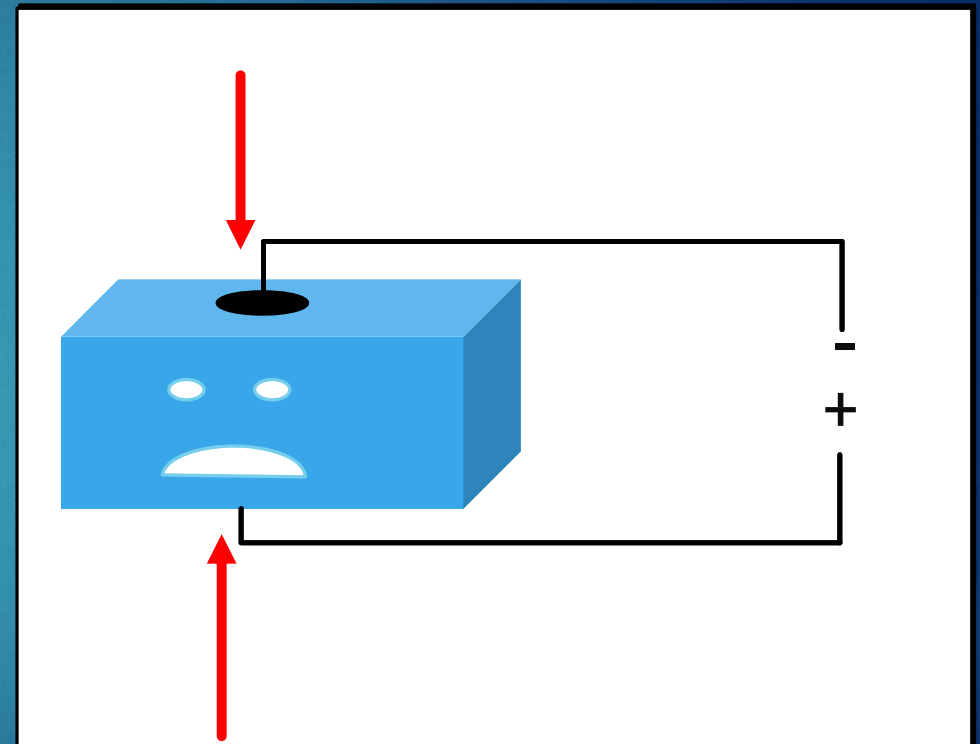
What is a Nanogenerator?

- ▶ Converts nano-scale mechanical energy into electrical energy through the piezoelectric effect
- ▶ Usually has an integrated circuit etched onto flexible material made of:
 - Substrate
 - Nanowires
 - Electrode



Piezoelectric Effect

- ▶ Phenomenon where certain crystalline materials create an electrical charge in response to mechanical strain
- ▶ Deformation of crystal lattice (without breaking) upsets the charge balance and creates a potential
- ▶ High Voltage
Low Current



Compression → Negative Voltage

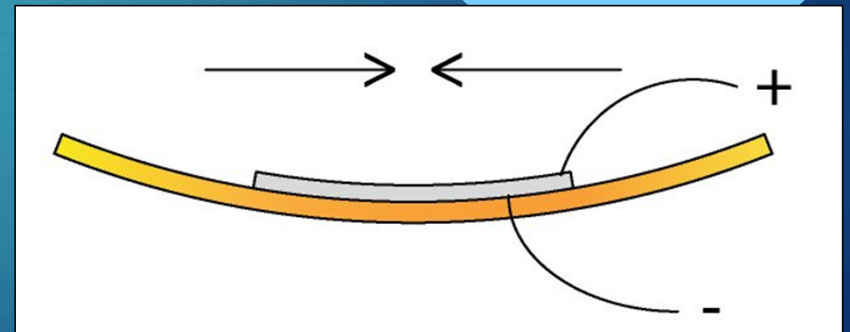
Zinc Oxide Nanowires

- ▶ Made from Piezoelectric Ceramic Material
- ▶ 100 – 300 nm wide
100 μm long
- ▶ 1 wire produces 45 mV

1. Nanowire on Metal Contact

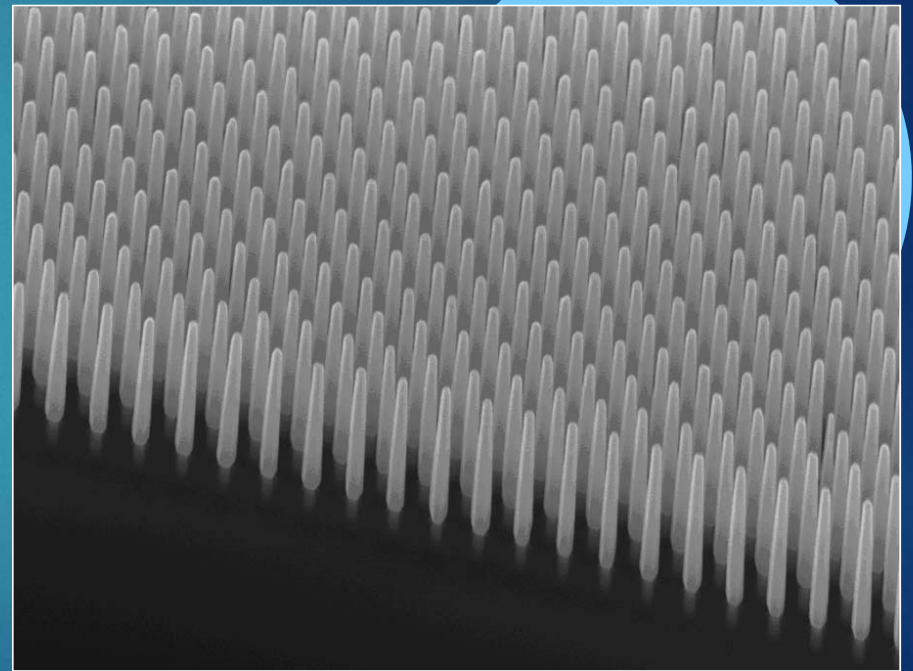


2. Bent Nanowire Producing Voltage



Array of ZnO Nanowires

- ▶ Use hundreds to millions of nanowires in an array
- ▶ Generate output simultaneously to increase power obtained



Putting it All Together

Vertical Nanowire Integrated Nanogenerator

1. Substrate

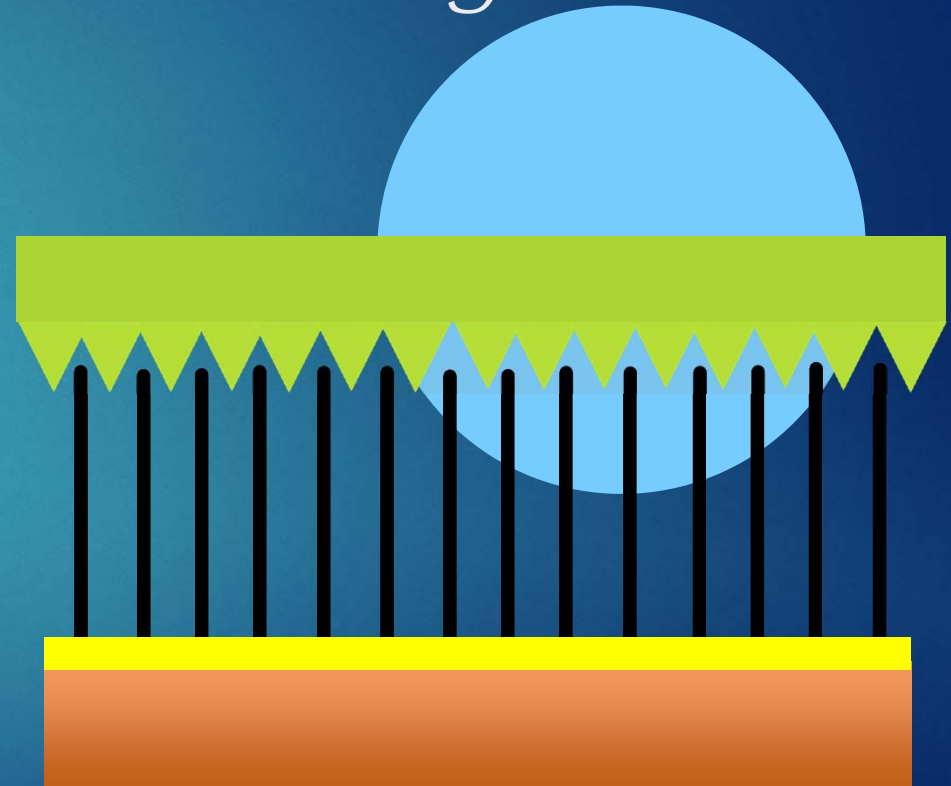
- Flexible Polymer Material
- Coated with Metal Contact
- Nanowire Array is grown onto this material

2. Nanowire Array

- Nanowire Array used to generating electricity from applied strain

3. Electrode

- “Zig-Zag” shaped
- Contains thousands of conductive-coated nanometer-sized tips
- Leaves enough room for nanowires to flex and periodically contact the tips



Putting it All Together

Lateral Nanowire Integrated Nanogenerator

1. Substrate

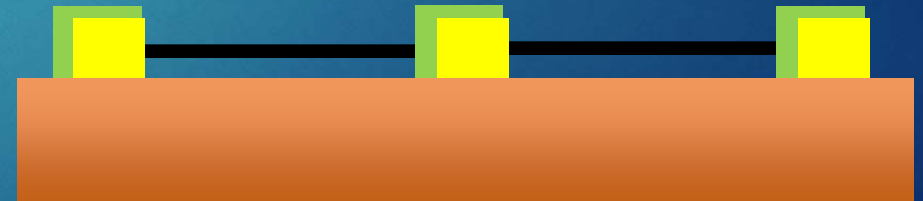
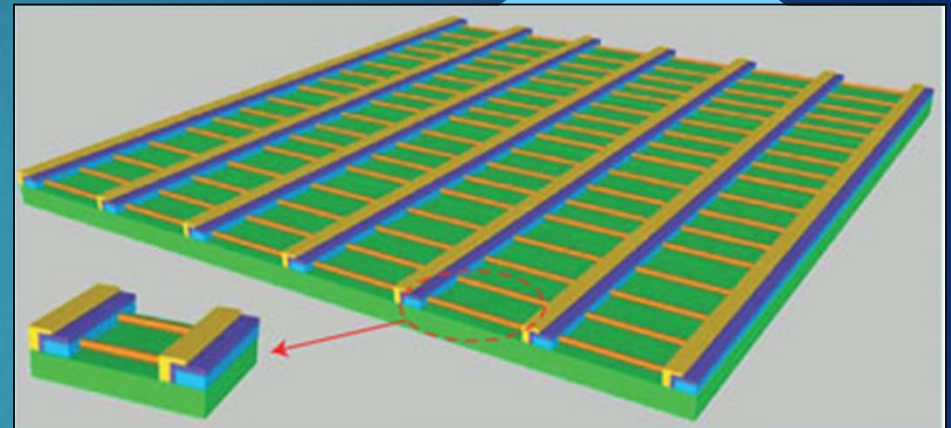
- Flexible Polymer Material

2. Electrodes (Two Types)

- Horizontally aligned nanowire array is grown laterally from the first electrode material
- The second electrode material is deposited at the other end for parallel electrical contact

3. Nanowire Array

- Rows of nanowires created to generate



Gives you higher output!

Possible Applications

- ▶ **Sensor:** monitor mechanical strain associated with bone loss
- ▶ **Generator:** power portable devices using the rustling of your clothes
- ▶ **Medical Devices:** Amplify the electrical signal created by small vibrations or sound waves
- ▶ **Many More!**

