A Guitar at the Nanoscale

UCSC

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Abstract

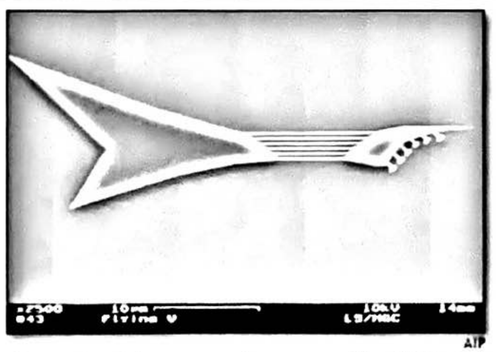
In this experiment, Lidija Sekaric and other researchers from Cornell University created the world's smallest playable guitar. The guitar, visible at the nanoscale, produces frequencies 130,000 times higher than that of a regular guitar. This development and its applications will pave the road for many different aspects of future nanotechnology.

Introduction

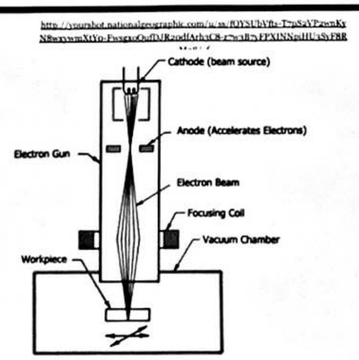
-In 1997, researchers at Cornell University created the smallest guitar which was about the size of a human red blood cell.
- In 2003, Cornell University upgraded the guitar by adding strings made of silicon wafers and a new sleek body made of silicon bars. This allowed the guitar to be playable.
-The playable nanoguitar contains strings that are resonant and are able to be tuned, which is the first step to creating more nano-sized instruments in the future.
-A laser is fired at the guitar strings which heats them intermittently and causes them to vibrate at 40 megahertz

Nanoguitars

- The dimensions of the first guitar are 10 μm in length and 2 μm in width.
- The dimensions of the second guitar are 150 by 200 nanometers in cross-sections and 12 micrometers in length. Compared to the first guitar, the size of the second increased 5 times in order to be playable.
- A focused laser is fired at the guitar strings, each with a width of 50 nanometers, or 200 atoms. The guitar strings are heated intermittently and vibrate at 40 megahertz, a frequency 130,000 times that of a regular guitar.
- The ability of nanomaterials to produce high frequencies, as demonstrated in the nanoguitar, paves the way for researchers to apply this ability in more useful areas, such as electronics



The picture is of the nanoguitar created by Lidija Sekaric and other researchers from Cornell University. The guitar is the smallest playable guitar containing a body etched of silicon wafers and string made from silicon bars. Lasers are aimed at the strings at frequencies of 40 megahertz



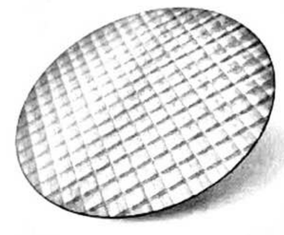
The labeled diagram of the Electron Beam demonstrates the different aspects of the instrument used to create the nano guitar. The electron beam focuses on certain areas to create custom patterns and designs in the process known as Electron Beam lithography.

Hypothesis

Etching technology demonstrated by the nanoguitar can be used to create transistors that are more efficient and sensitive than those produced by conventional methods.

Materials

- Silicon bars for strings
- Silicon wafers for body of guitar
- Scanning Electron Microscope (SEM)
- Electron Beam (E-Beam)



Silicon Wafers

Methods

- Lasers operated with an atomic force microscope are fired at the guitar strings which heats them intermittently and causes them to bend back and worth at 40 megahertz
- The nanoguitar was etched out of silicon wafers with electron beam lithiography
- Strings of guitar were created from silicon bars

Conclusion

Impact of Nanoguitar:

- Demonstrates the possible use of this nanotechnology in microcircuits, so circuits can become cheaper, smaller, and energy-efficient.
- The high frequency vibrations at a small scale could be used to transmit radio signals to replace quartz crystals for more compact electronics
- Paves the way for new forms of nanotechnology:
  - Robotics: smaller and more efficient robots can be created
  - Medicine: cheaper and effective procedures for diagnosing patients can be created
  - Dentistry: applications of this technology can speed up dental procedures including anesthesia, major tooth repair, etc

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