Extremely Electrically Small Antenna Based On Multiferroics

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SUMMARY

UCLA researchers in the Department of Mechanical and Aerospace Engineering have developed an extremely electrically small antenna that can be used to transmit or receive electromagnetic radiation within a large range of communication frequencies.

BACKGROUND

Radio frequency (RF) communication involves the exchange of electromagnetic waves that store information in their physical structure: amplitude, frequency, and phase. Low-power communication systems utilize low-amplitude, large-wavelength signals, requiring highly sensitive antennas to detect faint signal fluctuations, and necessitate very large antennas to capture the waves. High frequency waves allow high-speed communication, but generally require fast (expensive) electronics as well as antennas with exceptional workmanship. Mobile RF communication systems typically operate at ultra-high frequencies (UHF) and are commonly limited in size, weight, and power, requiring solutions that are both low-power and compact. Designs satisfying these competing criteria are rare, and in high-demand.

INNOVATION

Researchers at UCLA have found that the piezoelectric resonator resembles an infinitesimal dipole antenna in the induced electromagnetic fields, and the radiation efficiency of the piezoelectric resonator is superior to a current-driven electric dipole of the same size without matching network and ohmic loss taken into account. This suggests the potential advantage of manipulating electric polarizations to generate EM radiation at microscale. They came up with a novel electrically small antenna design, the structure of which can be optimized by using different magnetic materials and piezoelectric substrates to maximize the voltage output by the electrodes. The resulting antenna is capable of transmitting or receiving electromagnetic radiation of sufficient radiation power with extremely small chips/structures that are roughly a hundredth to a thousandth of the wavelength. The electrically small antenna design allows it to be used on small wireless devices for long-range, low frequency communication.

APPLICATIONS

- Handheld devices
- Wearables
- Low-profile aircraft antennae
- Bio-implantable devices
- Other small wireless devices

ADVANTAGES

- Electrically small antennae can be used under relative low frequency without the necessity to increase the chip size, which can be used for long-range wireless communication
- Fabrication process is scalable with high defect tolerance

STATE OF DEVELOPMENT

An antenna prototype is available and has been tested experimentally.

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	11,791,566	10/17/2023	2018-467

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OTHER INFORMATION

KEYWORDS

antenna, wireless communication, electromagnetic radiation, piezoelectric

CATEGORIZED AS

- **Communications**
  - Wireless
- **Engineering**
  - Engineering

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