POLARIZATION-INDEPENDENT FREQUENCY SELECTIVE SURFACES FOR ATMOSPHERIC REMOTE SENSING

IITM Technology Available for Licensing

Problem Statement

- Remote sensing radiometers require Frequency Selective Surfaces (FSS) to filter and demultiplex incoming electromagnetic (EM) waves within a wide frequency range (22–230 GHz) for weather monitoring.
- FSSs need to be designed to be insensitive to the polarization and angle of incidence of the EM plane waves to effectively capture and route spectral emissions.
- Current radiometers require FSS designs with characteristics such as insensitivity to polarization, wide operational bandwidth, and flexibility in accommodating various angles of incidence of EM plane waves.

Intellectual Property

- IITM IDF Ref. 1669
- **IN 373105 - Patent Granted**

Technology Category/ Market

Category - Atmospheric Remote Sensing
Applications- Radiometers, Spatial filters, phase and control metasurfaces, Satellite based weather forecasting and monitoring
Industry- Remote Sensing, Radar Systems, Satellite Communication

Market - The global remote sensing technology market size and is expected to hit around USD 55.36 billion by 2032, representing a CAGR of 11.79% from 2023 - 2032.

TRL (Technology Readiness Level)

TRL - 4: Technology validated in lab scale.

Research Lab

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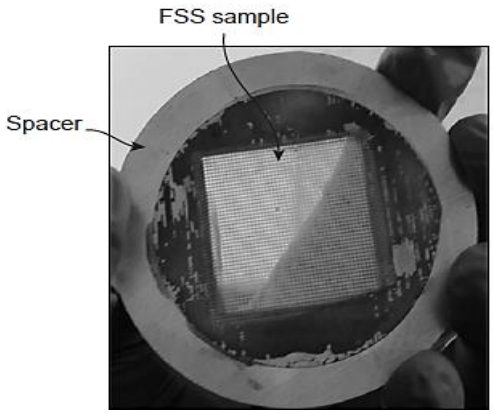

FIG. 1. Shows the Cascaded two-layer FSS on 875µm thick metal spacer.

Technology

1. The invention discloses **frequency selective surface (FSS) unit cells that are capable of de-multiplexing the ultralow-power polarized plane wave from the earth's atmosphere.**
2. **A miniaturized resonant FSS unit cell** with angle and polarization stable frequency response is disclosed.
3. The unit cell includes **a corner convoluted square ring that has parasitic patches** on the four sides and is coupled to a cross dipole at the centre.
4. **The unit cell rejects 50- 60 GHz and 170–195 GHz and transmits 87- 91 GHz.** Further, a quadband millimeter wave frequency FSS unit cell that has a circular metal mesh loaded with a monopole integrated concentric ring on a quartz substrate is disclosed.
5. The unit cell is cascaded and is capable of rejecting bandwidths in the range 50–60 GHz, 87–91 GHz, and 148–151 GHz, and transmitting in the range 175–195 GHz. The FSS may be used in atmospheric remote sensing.

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Key Features / Value Proposition

1. **Miniaturized FSS Unit Cell:** This invention presents a compact unit cell for Frequency Selective Surfaces (FSS) designed to manipulate millimeter wave signals.
2. **Reflect and Transmit:** The unit cell selectively reflects specific signal portions while substantially transmitting the rest of the incident millimeter wave signal.
3. **Metal Ring Structure:** It features a metal layer forming a connected four-sided ring structure with uniform trace widths.
4. **Symmetric Dipole Structure:** Inside the ring, a symmetric dipole structure with four arms is positioned at a specific distance from each side.
5. **Mutual Coupling:** When interacting with an incident millimeter wave signal, the unit cell allows mutual coupling between the ring and dipole structures, enabling precise signal reflection and transmission..

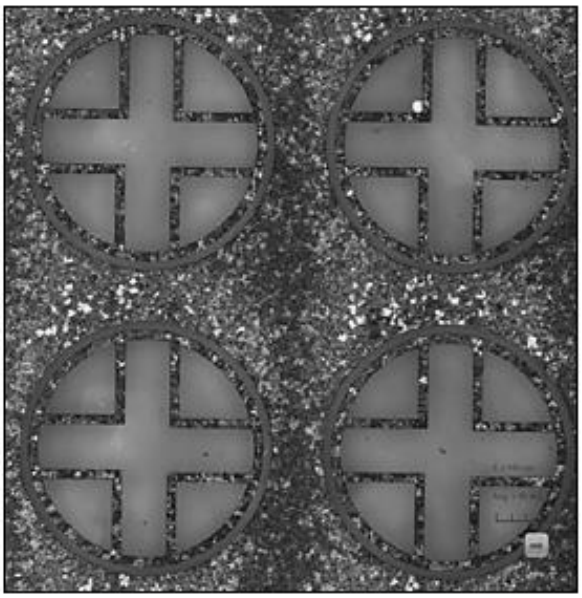

FIG. 5. illustrates the microscopic image of the fabricated unit cells.

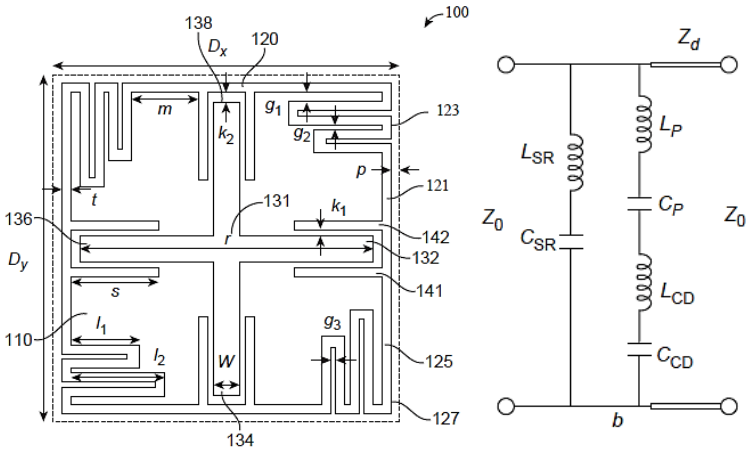

FIG. 2A. illustrates the unit cell geometry of the miniaturized resonant FSS.
FIG. 2B. illustrates the equivalent circuit representation of the transmission line model.

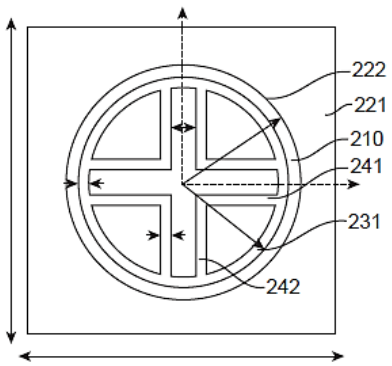

FIG. 3 illustrates the unit cell geometry of quad-band millimetre wave frequency selective surface.

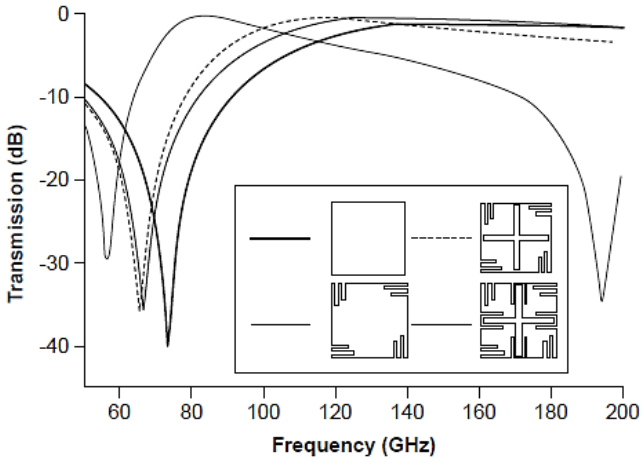

FIG. 4 illustrates the computed transmission response showing the evolution of the miniaturised unit cell for normal incidence.

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