US012341256B2

(12) **United States Patent**
**Lin et al.**

(10) **Patent No.: US 12,341,256 B2**
(45) **Date of Patent: Jun. 24, 2025**

(54) **DUAL-POLARIZATION CAVITY-BACKED ANTENNA, PACKAGE MODULE, AND ARRAY PACKAGE MODULE**

(71) Applicant: **National Taiwan University**, Taipei (TW)

(72) Inventors: **Yi-Cheng Lin**, Taipei (TW); **Tzu-Ming Huang**, Taipei (TW)

(73) Assignee: **NATIONAL TAIWAN UNIVERSITY**, Taipei (TW)

( * ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 209 days.

(21) Appl. No.: **18/216,448**

(22) Filed: **Jun. 29, 2023**

(65) **Prior Publication Data**

US 2025/0007179 A1 Jan. 2, 2025

(51) **Int. Cl.**
***H01Q 21/24*** (2006.01)
***H01Q 1/50*** (2006.01)
***H01Q 1/52*** (2006.01)

(52) **U.S. Cl.**
CPC ..... ***H01Q 21/24*** (2013.01); ***H01Q 1/50*** (2013.01); ***H01Q 1/52*** (2013.01)

(58) **Field of Classification Search**
None
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2020/0373666 A1* 11/2020 Takaki ..... H01Q 5/307
2021/0159610 A1* 5/2021 Manesh ..... H01Q 21/24
2022/0344832 A1* 10/2022 Sayama ..... H01Q 21/065
2023/0089629 A1* 3/2023 Ouyang ..... H05K 1/02 343/720
2024/0339763 A1* 10/2024 Morita ..... H01Q 23/00
2024/0356214 A1* 10/2024 Steward ..... H01Q 21/065
2024/0356222 A1* 10/2024 Chiang ..... H01Q 1/50
2024/0421465 A1* 12/2024 Acikalin ..... H01L 23/66
2024/0421479 A1* 12/2024 Hwang ..... H01Q 5/50

FOREIGN PATENT DOCUMENTS

TW I481115 B 4/2015

* cited by examiner

*Primary Examiner* — Wilson Lee
(74) *Attorney, Agent, or Firm* — Birch, Stewart, Kolasch & Birch, LLP

(57) **ABSTRACT**

Disclosed are a dual-polarization cavity-backed antenna, a package module and an array package module. The antenna includes a substrate, a magnetic current feeding structure, an electric current feeding structure, and a cavity-backed structure that is arranged between two surfaces of the substrate. The magnetic current feeding structure and the electric current feeding structure transfer energy into the cavity-backed structure, respectively radiating the orthogonally polarized electromagnetic wave. The electric field direction of the first electromagnetic wave and the magnetic field direction of the second electromagnetic wave occur on the same plane. The package module includes the dual-polarization cavity-backed antenna, a radio frequency control chip, and a control circuit unit. The array package module includes a plurality of the dual-polarization cavity-backed antennas, a radio frequency control unit including a single RF chip or chip set, and a control circuit unit.

**10 Claims, 6 Drawing Sheets**