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(54) DIELECTRIC FILTER ANTENNA, ELECTRONIC DEVICE, AND ANTENNA ARRAY

(57) This application provides a dielectric filter antenna, an electronic device, and an antenna array. The dielectric filter antenna includes a dielectric antenna and at least one layer of dielectric resonant cavity. The dielectric antenna is located at a top layer. The at least one layer of dielectric resonant cavity is located below the dielectric antenna. Energy coupling is performed between the dielectric antenna and a dielectric resonant cavity adjacent to the dielectric antenna. Materials of the

dielectric antenna and the dielectric resonant cavity are a ceramic dielectric with a high dielectric constant. The energy coupling is performed between the dielectric antenna of the dielectric filter antenna in this application and the dielectric resonant cavity adjacent to the dielectric antenna, to avoid use of a transmission line or a matching circuit and avoid an insertion loss, thereby implementing a small size and good echo performance.

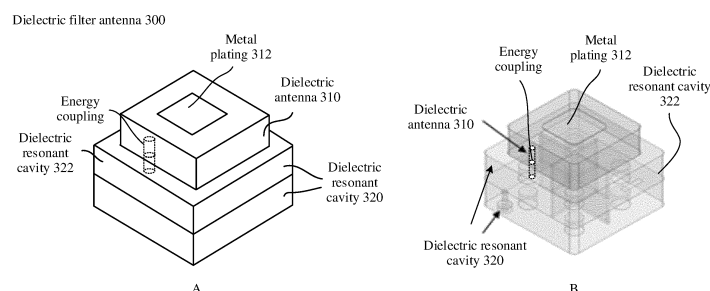


FIG. 3

Description

[0001] This application claims priority to Chinese Patent Application No. 202010602533.2, filed with the China National Intellectual Property Administration on June 29, 2020 and entitled "DIELECTRIC FILTER ANTENNA, ELECTRONIC DEVICE, AND ANTENNA ARRAY", which is incorporated herein by reference in its entirety.

TECHNICAL FIELD

[0002] This application relates to the antenna field, and more specifically, to a dielectric filter antenna, an electronic device, and an antenna array.

BACKGROUND

[0003] With the development of modern wireless communication technologies, communications systems tend to be miniaturized, integrated, and multi-functional. Correspondingly, a communications device has an increasingly high requirement for a radio frequency front-end circuit. An antenna and a filter are two key components of the radio frequency front-end circuit. In an existing solution, the antenna and the filter are independently designed. The antenna and the filter need to be cascaded by using a transmission line or a matching circuit, to implement impedance matching and work in coordination. The additional transmission line or matching circuit inevitably causes an increase in a size of an entire antenna system, reduction in performance of the entire antenna system, and generation of an additional transmission loss.

SUMMARY

[0004] This application provides a dielectric filter antenna, an electronic device, and an antenna array, to avoid use of a transmission line or a matching circuit and avoid an insertion loss, thereby implementing a small size and good echo performance.

[0005] According to a first aspect, a dielectric filter antenna is provided, including a dielectric antenna and at least one layer of dielectric resonant cavity. The dielectric antenna is located at a top layer. The at least one layer of dielectric resonant cavity is located below the dielectric antenna. Energy coupling is performed between the dielectric antenna and a dielectric resonant cavity adjacent to the dielectric antenna. Materials of the dielectric antenna and the dielectric resonant cavity are a ceramic dielectric with a high dielectric constant.

[0006] The dielectric filter antenna in the first aspect includes the dielectric antenna located at the top layer and the at least one layer of dielectric resonant cavity located below the dielectric antenna. The energy coupling is performed between the dielectric antenna and the dielectric resonant cavity adjacent to the dielectric antenna, to avoid use of a transmission line or a matching

circuit and avoid an insertion loss, thereby implementing a small size and good echo performance.

[0007] The dielectric antenna of the dielectric filter antenna in the first aspect serves as both an antenna and a last-level resonant cavity of a dielectric filter, and constitutes the dielectric filter together with the at least one layer of dielectric resonant cavity. In other words, the dielectric filter antenna is both an antenna and a filter. The dielectric filter antenna in the first aspect can implement a radiation function of the antenna while implementing functions of the filter.

[0008] In the dielectric filter antenna of the first aspect, a filter structure, a common component structure, and a radiation structure are cooperatively designed, thereby avoiding a case of echo deterioration at an input port of the filter due to a cascading effect in a conventional solution.

[0009] The dielectric filter antenna in the first aspect may be designed in a stacked manner. Based on the stacked design, the transmission line or the matching circuit can be avoided between the filter and the antenna. In other words, a path of a feeding network can be reduced, to reduce an overall insertion loss.

[0010] A size of the dielectric antenna in the dielectric filter antenna in the first aspect is greatly reduced. The transmission line or the matching circuit does not need to be used for connection between the dielectric antenna and the at least one layer of dielectric resonant cavity, to avoid an insertion loss introduced due to use of the transmission line or the matching circuit. The filter and the antenna are designed to be integrated. The entire structure is compact. In this way, structures in the antenna system can be effectively reduced, a size of the antenna system can be greatly reduced, and development requirements for miniaturization, integration, and high performance of the antenna system can be better met.

[0011] In the dielectric filter antenna in the first aspect, both the filter and the antenna are made of a ceramic dielectric with a high dielectric constant through processing, to effectively reduce the size of the structure.

[0012] In a possible implementation of the first aspect, all surfaces of each dielectric resonant cavity in the at least one layer of dielectric resonant cavity have metal plating. In this possible implementation, a metal layer is plated on all the surfaces of the dielectric resonant cavity, to prevent energy of the resonant cavity from leaking out and improve performance of the dielectric resonant cavity.

[0013] In a possible implementation of the first aspect, a part of a surface of the dielectric antenna has metal plating. In this possible implementation, a metal layer is plated on the part of the surface of the dielectric antenna, to adjust a frequency of the dielectric antenna.

[0014] In the foregoing possible implementation, a material of the metal plating may be silver, gold, tin, or the like. This is not limited in this application.

[0015] In a possible implementation of the first aspect, the energy coupling is performed between the dielectric

antenna and the dielectric resonant cavity adjacent to the dielectric antenna by using a slot, a probe, or a surface metal layer disposed on the dielectric antenna and the dielectric resonant cavity adjacent to the dielectric antenna. In this possible implementation, based on shapes, sizes, and relative locations of the dielectric antenna and the dielectric resonant cavity, one or a combination of the slot, the probe, or the surface metal layer may be used to complete energy coupling between the dielectric antenna and the dielectric resonant cavity, to avoid an insertion loss introduced due to use of the transmission line or the matching circuit.

[0016] In a possible implementation of the first aspect, a first slot is disposed inward from a bottom surface of the dielectric antenna, and a second slot is disposed inward from a top surface of the dielectric resonant cavity adjacent to the dielectric antenna. A location of the first slot is aligned with that of the second slot. The energy coupling is performed between the dielectric antenna and the dielectric resonant cavity adjacent to the dielectric antenna by using the first slot and the second slot.

[0017] In a possible implementation of the first aspect, a first probe is disposed inward from a bottom surface of the dielectric antenna, and a second probe is disposed inward from a top surface of the dielectric resonant cavity adjacent to the dielectric antenna. A location of the first probe is aligned with that of the second probe. The energy coupling is performed between the dielectric antenna and the dielectric resonant cavity adjacent to the dielectric antenna by using the first probe and the second probe.

[0018] In the previous possible implementation, the first probe and the second probe are both metalized through-holes, and the first probe and the second probe are connected by using a pad.

[0019] In a possible implementation of the first aspect, a surface metal layer is disposed on a side surface of the dielectric antenna, and a probe is disposed inward from a top surface of the dielectric resonant cavity adjacent to the dielectric antenna. A location of the surface metal layer is aligned with that of the probe. The energy coupling is performed between the dielectric antenna and the dielectric resonant cavity adjacent to the dielectric antenna by using the surface metal layer and the probe.

[0020] In the previous possible implementation, the probe is a metalized through-hole, and the probe and the surface metal layer are connected by using a pad.

[0021] In a possible implementation of the first aspect, the dielectric antenna is a dual-polarized antenna. In this way, a dual-polarized dielectric filter antenna can be formed.

[0022] According to a second aspect, an electronic device is provided, including the dielectric filter antenna according to the first aspect and any possible implementation of the first aspect.

[0023] According to a third aspect, an antenna array is provided, including the dielectric filter antenna according to the first aspect and any possible implementation of the first aspect. A plurality of dielectric filter antennas

form an array in a horizontal direction and/or a vertical direction. In the third aspect, the antenna array has a small granularity and a highly free layout.

[0024] In a possible implementation of the third aspect, the antenna array is applied to a network device, for example, a base station.

BRIEF DESCRIPTION OF DRAWINGS

[0025]

FIG. 1 is a schematic diagram in which an antenna and a filter are connected by using a transmission line;

FIG. 2 is a schematic diagram of an antenna and a filter;

FIG. 3 is a schematic diagram of a dielectric filter antenna according to an embodiment of this application;

FIG. 4 is a schematic diagram of a dielectric filter antenna according to an embodiment of this application;

FIG. 5 is a schematic diagram of a dielectric filter antenna according to an embodiment of this application;

FIG. 6 is a schematic diagram of a dielectric filter antenna according to an embodiment of this application;

FIG. 7 is a schematic diagram of a dual-polarized dielectric filter antenna according to an embodiment of this application; and

FIG. 8 is a diagram of comparison between echo performance of a dielectric filter antenna and that of an existing antenna according to an embodiment of this application.

DESCRIPTION OF EMBODIMENTS

[0026] The following describes technical solutions of this application with reference to the accompanying drawings.

[0027] First, an existing antenna and an existing filter are briefly described.

[0028] In an existing solution, the antenna and the filter are independently designed and processed as two components based on agreed port characteristic impedance. FIG. 1 is a schematic diagram in which an antenna and a filter are connected by using a transmission line (which may be in a module). As shown in FIG. 1, a filter 110 has an input port 112 and an output port 114, and an antenna 120 has an input port 122. One end of a transmission line 130 is connected to the output port 114 of the filter 110, and the other end is connected to the input port 122 of the antenna 120. The transmission line may be replaced with a matching circuit (also referred to as a feed-in circuit). The antenna and the filter are independently designed and processed based on agreed port characteristic impedance, for example, 50 ohms. Port charac-

teristic impedance of the two devices, namely, the filter and antenna, cannot be completely equal to the agreed port characteristic impedance (50 ohms) within an operating bandwidth range. After the two devices are cascaded by using the transmission line or the matching circuit, echo performance at the input port 112 of the filter seriously deteriorates. In addition, the transmission line or the matching circuit needs to be used to connect the filter to the antenna. This may cause an insertion loss, thereby increasing a loss of an antenna system.

[0029] FIG. 2 is a schematic diagram of an antenna and a filter. As shown in FIG. 2, in an existing solution, a passive device of a radio frequency front-end circuit includes three parts: a filter 210, a transmission line (or a matching circuit), and an antenna 220 (the antenna 220 in FIG. 2 includes a transmission line or a matching circuit). A large quantity of components does not facilitate miniaturization. In addition, in the existing solution, operating bandwidths of both the filter and the antenna need to be greater than an operating bandwidth of an antenna system. Because the bandwidth of the antenna is directly proportional to a size of the antenna, it is difficult to miniaturize the antenna.

[0030] Based on the foregoing problem, this application provides a dielectric filter antenna, an electronic device, and an antenna array.

[0031] FIG. 3 is a schematic diagram of a dielectric filter antenna 300 according to an embodiment of this application. In FIG. 3, A is a schematic diagram, and B is a perspective view. As shown in FIG. 3, the dielectric filter antenna 300 includes a dielectric antenna 310 and at least one layer of dielectric resonant cavity 320. The dielectric antenna 310 is located at a top layer. The at least one layer of dielectric resonant cavity 320 is located below the dielectric antenna 310. Energy coupling is performed between the dielectric antenna 310 and a dielectric resonant cavity 322 adjacent to the dielectric antenna. Materials of the dielectric antenna 310 and the dielectric resonant cavity 320 are a ceramic dielectric with a high dielectric constant.

[0032] The dielectric filter antenna provided in embodiments of this application includes the dielectric antenna located at the top layer and the at least one layer of dielectric resonant cavity located below the dielectric antenna. The energy coupling is performed between the dielectric antenna and the dielectric resonant cavity adjacent to the dielectric antenna, to avoid use of a transmission line or a matching circuit and avoid an insertion loss, thereby implementing a small size and good echo performance.

[0033] The dielectric antenna in embodiments of this application serves as both an antenna and a last-level resonant cavity of a dielectric filter, and constitutes the dielectric filter together with the at least one layer of dielectric resonant cavity. In other words, the dielectric filter antenna in embodiments of this application is both an antenna and a filter. The filter includes a plurality of resonant cavities (resonators). In embodiments of this ap-

plication, the last-level resonant cavity is implemented by a dielectric antenna, and the remaining resonant cavities are implemented by dielectric resonant cavities. The dielectric filter antenna in embodiments of this application includes two or more layers of dielectric blocks (dielectric antennas or dielectric resonant cavities). The top layer is a dielectric antenna, and the remaining layer is a dielectric resonant cavity. The dielectric filter antenna provided in embodiments of this application can implement a radiation function of the antenna while implementing functions of the filter.

[0034] In embodiments of this application, a filter structure (the filter), a common component structure (the transmission line or the matching circuit), and a radiation structure (the antenna) are cooperatively designed, thereby avoiding echo deterioration at an input port of the filter that is caused due to a cascading effect in a conventional solution. An S parameter (for example, |S₁₁|) of the dielectric filter antenna in embodiments of this application is significantly improved, and a radiation power gain of the antenna system is also significantly increased.

[0035] The dielectric filter antenna in embodiments of this application may be designed in a stacked manner. Based on the stacked design, the transmission line or the matching circuit can be avoided between the filter and the antenna. In other words, a path of a feeding network can be reduced, to reduce an overall insertion loss.

[0036] An operating bandwidth of the dielectric antenna in embodiments of this application may be far less than an operating bandwidth of the antenna system, while a bandwidth of a conventional antenna needs to be greater than the operating bandwidth of the antenna system. Therefore, a size of the dielectric antenna in embodiments of this application is greatly reduced. The transmission line or the matching circuit does not need to be used for connection between the dielectric antenna and the at least one layer of dielectric resonant cavity, to avoid an insertion loss introduced due to use of the transmission line or the matching circuit. The filter and the antenna are designed to be integrated. The entire structure is compact. In this way, structures in the antenna system can be effectively reduced, a size of the antenna system can be greatly reduced, and development requirements for miniaturization, integration, and high performance of the antenna system can be better met.

[0037] It should be understood that in this application, the high dielectric constant is a relatively high dielectric constant that can be applied to a dielectric antenna or a dielectric filter. For example, the dielectric constant may be greater than 6 or greater than 8. However, a case in which the dielectric constant is less than or equal to 6, or less than or equal to 8 is not excluded in this application, provided that requirements for filtering and antenna radiation can be met.

[0038] It should be further understood that, in this application, the ceramic dielectric with the high dielectric constant may include but is not limited to a ceramic ma-

terial, for example, a ceramic material with a main component of barium titanate (BaTiO_3), a ceramic material with a main component of barium carbonate (BaCO_3), a $\text{BaO-Ln}_2\text{O}_3\text{-TiO}_3$ series ceramic material, a composite perovskite series ceramic material, or a lead-based perovskite series ceramic material; or another similar ceramic material. This is not limited in this application. In this application, both the filter and the antenna are made of the ceramic dielectric with the high dielectric constant through processing, to effectively reduce the size of the structure.

[0039] In some embodiments of this application, the dielectric antenna in the dielectric filter antenna may be in a rectangular column shape or a cylinder shape, and the dielectric resonant cavity may also be in a rectangular column shape or a cylinder shape. The size of the dielectric antenna may be greater than or equal to the size of the dielectric resonant cavity, or may be less than the size of the dielectric resonant cavity. This is not limited in this application.

[0040] In some embodiments of this application, all surfaces of each dielectric resonant cavity in the at least one layer of dielectric resonant cavity may have metal plating. A metal layer is plated on all the surfaces of the dielectric resonant cavity, to prevent energy of the resonant cavity from leaking out and improve performance of the dielectric resonant cavity.

[0041] In some embodiments of this application, a part of a surface of the dielectric antenna has metal plating. A metal layer is plated on the part of the surface of the dielectric antenna, to adjust a frequency of the dielectric antenna. The part of the surface may be all or a part of a top surface of the dielectric antenna, or may be all or a part of a side surface of the dielectric antenna. For example, the part of the top surface of the dielectric antenna 310 of the dielectric filter antenna 300 shown in FIG. 3 has metal plating 312. The metal plating may alternatively not be disposed on the surface of the dielectric antenna. This is not limited in this application.

[0042] In some embodiments of this application, layers of dielectric blocks may be sintered by using the metal plating on the surface. All the surfaces of the dielectric resonant cavity may have metal plating. A bottom surface of the dielectric antenna may have metal plating to facilitate sintering.

[0043] In embodiments of this application, a material of the metal plating may be silver, gold, tin, or the like. This is not limited in this application.

[0044] In some embodiments of this application, the energy coupling is performed between the dielectric antenna and the dielectric resonant cavity adjacent to the dielectric antenna by using a slot, a probe, or a surface metal layer disposed on the dielectric antenna and the dielectric resonant cavity adjacent to the dielectric antenna. Based on shapes, sizes, and relative locations of the dielectric antenna and the dielectric resonant cavity, one or a combination of the slot, the probe, or the surface metal layer may be used to complete energy coupling

between the dielectric antenna and the dielectric resonant cavity.

[0045] In some specific embodiments, energy coupling may be performed between the dielectric antenna and the dielectric resonant cavity adjacent to the dielectric antenna by using the slot. FIG. 4 is a schematic diagram of a dielectric filter antenna 400 according to an embodiment of this application. As shown in FIG. 4, a first slot 414 is disposed inward from a bottom surface of a dielectric antenna 410, and a second slot 424 is disposed inward from a top surface of a dielectric resonant cavity 420 adjacent to the dielectric antenna. A location of the first slot 414 is aligned with that of the second slot 424. The energy coupling is performed between the dielectric antenna 410 and the dielectric resonant cavity 420 adjacent to the dielectric antenna by using the first slot 414 and the second slot 424.

[0046] In the structure shown in FIG. 4, unmetalized slots are disposed on sintering surfaces (a bottom surface of the dielectric antenna and a top surface of the dielectric resonant cavity adjacent to the dielectric antenna) of the dielectric antenna (a last-level dielectric resonant cavity) and the dielectric resonant cavity adjacent to the dielectric antenna (a penultimate-level dielectric resonant cavity), to implement energy coupling. The slot may be a strip-shaped slot shown in FIG. 4. The first slot 414 may not penetrate the dielectric antenna. The second slot 424 may not penetrate the dielectric resonant cavity adjacent to the dielectric antenna. A specific form of the slot may be a square hole or a circular hole, or may be in another shape. This is not limited in this application.

[0047] In some specific embodiments, energy coupling may be performed between the dielectric antenna and the dielectric resonant cavity adjacent to the dielectric antenna by using the probe. FIG. 5 is a schematic diagram of a dielectric filter antenna 500 according to an embodiment of this application. As shown in FIG. 5, a first probe 514 is disposed inward from a bottom surface of a dielectric antenna 510, and a second probe 524 is disposed inward from a top surface of a dielectric resonant cavity 520 adjacent to the dielectric antenna. A location of the first probe 514 is aligned with that of the second probe 524. The energy coupling is performed between the dielectric antenna 510 and the dielectric resonant cavity 520 adjacent to the dielectric antenna 510 by using the first probe 514 and the second probe 524.

[0048] In the structure shown in FIG. 5, probes are disposed on sintering surfaces (a bottom surface of the dielectric antenna and a top surface of the dielectric resonant cavity adjacent to the dielectric antenna) of the dielectric antenna (a last-level dielectric resonant cavity) and the dielectric resonant cavity adjacent to the dielectric antenna (a penultimate-level dielectric resonant cavity), to implement energy coupling. Specifically, the first probe 514 and the second probe 524 may be both metalized through-holes, and the first probe 514 and the second probe 524 are connected by using a pad. The probe may be in a strip shape shown in FIG. 5. The first probe

514 may not penetrate the dielectric antenna. The second probe 524 may not penetrate the dielectric resonant cavity adjacent to the dielectric antenna 510.

[0049] In some specific embodiments, energy coupling may be performed between the dielectric antenna and the dielectric resonant cavity adjacent to the dielectric antenna in a form of the probe plus the surface metal layer. FIG. 6 is a schematic diagram of a dielectric filter antenna 600 according to an embodiment of this application. As shown in FIG. 6, a surface metal layer 614 is disposed on a side surface of the dielectric antenna 610, and a probe 624 is disposed inward from a top surface of the dielectric resonant cavity 620 adjacent to the dielectric antenna 610. A location of the surface metal layer 614 is aligned with that of the probe 624. The energy coupling is performed between the dielectric antenna 610 and the dielectric resonant cavity 620 adjacent to the dielectric antenna 610 by using the surface metal layer 614 and the probe 624.

[0050] In the structure shown in FIG. 6, a probe and a surface metal layer are disposed inward from sintering surfaces (a bottom surface of the dielectric antenna and a top surface of the dielectric resonant cavity adjacent to the dielectric antenna) of the dielectric antenna (a last-level dielectric resonant cavity) and the dielectric resonant cavity adjacent to the dielectric antenna (a penultimate-level dielectric resonant cavity), to implement energy coupling. Specifically, the probe 624 may be a metalized through-hole, and the surface metal layer 614 may be a small strip-shaped piece of metal plating. The probe may be in a strip shape shown in FIG. 6. The probe 624 may not penetrate the dielectric antenna. The probe 624 may be connected to the surface metal layer 614 by using a pad.

[0051] In some embodiments of this application, the dielectric antenna may be dual-polarized antenna. In this way, a dual-polarized dielectric filter antenna can be formed. FIG. 7 is a schematic diagram of a dual-polarized dielectric filter antenna 700 according to an embodiment of this application. Herein, A in FIG. 7 is a solid figure of a dual-polarized dielectric filter antenna 700, B in FIG. 7 is a top view of the dual-polarized dielectric filter antenna 700, and C in FIG. 7 is a side view of the dual-polarized dielectric filter antenna 700. As shown in FIG. 7, the dual-polarized dielectric filter antenna has two feed ports (connectors). Each feed port corresponds to one channel and one channel of a signal. Polarization directions of the two channels of signals may be orthogonal, for example, +45 degrees and -45 degrees. Each channel of a signal passes through one dielectric filter with eight dielectric resonant cavities plus one cavity of the dielectric antenna. There are nine cavities in total, that is, nine orders. In other words, the dual-polarized dielectric filter antenna shown in FIG. 7 is a dual-polarized nine-order dielectric filter antenna. The dual-polarized nine-order dielectric filter antenna is common in an antenna system of a base station. Embodiments of this application further provide a dielectric filter antenna of another number of orders.

For example, if a layer of eight dielectric resonant cavities is further added, a dual-polarized 17-order dielectric filter antenna may be formed.

[0052] Echo performance of the dielectric filter antenna provided in this embodiment of this application is greatly improved. FIG. 8 is a diagram of comparison between echo performance of a dielectric filter antenna and that of an existing antenna according to an embodiment of this application. FIG. 8 shows S parameters of the dielectric filter antenna in this embodiment of this application and the existing antenna when the two antennas have the same size. It can be learned from FIG. 8 that, when an S parameter of -20 dB is used as an example, an operating bandwidth of the dielectric filter antenna in this embodiment of this application is approximately from 3.50 GHz to 3.63 GHz, and an operating bandwidth of the existing antenna is only approximately from 3.54 GHz to 3.57 GHz. The operating bandwidth of the dielectric filter antenna in this embodiment of this application is obviously improved. In this case, echo performance is greatly improved. In addition, miniaturization of the antenna system is better implemented because the operating bandwidth is greatly improved.

[0053] For the dielectric filter antenna provided in embodiments of this application, an entire structure is formed through splicing a plurality of layers of dielectric blocks. Only simple operations such as puncturing, metal plating, and sintering need to be performed on the dielectric blocks. The dielectric filter antenna has low processing difficulty, low costs, and good performance consistency.

[0054] This application further provides an electronic device. The electronic device includes the dielectric filter antenna described in the foregoing embodiments of this application.

[0055] This application further provides an antenna array, including a plurality of dielectric filter antennas described in the foregoing embodiments of this application. In the antenna array, the plurality of dielectric filter antennas form an array in a horizontal direction and/or a vertical direction.

[0056] In this embodiment of this application, the antenna array has a small granularity and highly free layout. A dual-polarized dielectric filter antenna unit in this embodiment of this application may correspond to two polarized channels of ± 45 degrees. The antenna array may be formed through arranging a plurality of dual-polarized dielectric filter antennas in the horizontal direction and/or the vertical direction.

[0057] The antenna array in this embodiment of this application may be applied to a network device, for example, to a base station.

[0058] It should be further understood that various numerical symbols in this specification are differentiated merely for ease of description, but are not used to limit the scope of this application.

[0059] The technical features in the foregoing embodiments may be combined in any manner. To make the

description brief, all possible combinations of the technical features in the foregoing embodiments are not described. However, provided that the combinations of the technical features do not conflict with each other, it should be considered as the scope recorded in this specification. [0060] The foregoing descriptions are merely specific implementations of this application, but are not intended to limit the protection scope of this application. Any variation or replacement readily figured out by a person skilled in the art within the technical scope disclosed in this application shall fall within the protection scope of this application. Therefore, the protection scope of this application shall be subject to the protection scope of the claims.

Claims

1. A dielectric filter antenna, comprising a dielectric antenna and at least one layer of dielectric resonant cavity, wherein the dielectric antenna is located at a top layer, the at least one layer of dielectric resonant cavity is located below the dielectric antenna, energy coupling is performed between the dielectric antenna and a dielectric resonant cavity adjacent to the dielectric antenna, and materials of the dielectric antenna and the dielectric resonant cavity are a ceramic dielectric with a high dielectric constant.
2. The dielectric filter antenna according to claim 1, wherein the energy coupling is performed between the dielectric antenna and the dielectric resonant cavity adjacent to the dielectric antenna by using a slot, a probe, or a surface metal layer disposed on the dielectric antenna and the dielectric resonant cavity adjacent to the dielectric antenna.
3. The dielectric filter antenna according to claim 1 or 2, wherein a first slot is disposed inward from a bottom surface of the dielectric antenna, a second slot is disposed inward from a top surface of the dielectric resonant cavity adjacent to the dielectric antenna, a location of the first slot is aligned with that of the second slot, and the energy coupling is performed between the dielectric antenna and the dielectric resonant cavity adjacent to the dielectric antenna by using the first slot and the second slot.
4. The dielectric filter antenna according to claim 1 or 2, wherein a first probe is disposed inward from a bottom surface of the dielectric antenna, a second probe is disposed inward from a top surface of the dielectric resonant cavity adjacent to the dielectric antenna, a location of the first probe is aligned with that of the second probe, and the energy coupling is performed between the dielectric antenna and the dielectric resonant cavity adjacent to the dielectric antenna by using the first probe and the second
- probe.
5. The dielectric filter antenna according to claim 4, wherein the first probe and the second probe are both metalized through-holes, and the first probe and the second probe are connected by using a pad.
6. The dielectric filter antenna according to claim 1 or 2, wherein a surface metal layer is disposed on a side surface of the dielectric antenna, a probe is disposed inward from a top surface of the dielectric resonant cavity adjacent to the dielectric antenna, a location of the surface metal layer is aligned with that of the probe, and the energy coupling is performed between the dielectric antenna and the dielectric resonant cavity adjacent to the dielectric antenna by using the surface metal layer and the probe.
7. The dielectric filter antenna according to claim 6, wherein the probe is a metalized through-hole, and the probe and the surface metal layer are connected by using a pad.
8. The dielectric filter antenna according to any one of claims 1 to 7, wherein the dielectric antenna is a dual-polarized antenna.
9. The dielectric filter antenna according to any one of claims 1 to 8, wherein a part of a surface of the dielectric antenna has metal plating.
10. The dielectric filter antenna according to any one of claims 1 to 9, wherein all surfaces of each dielectric resonant cavity in the at least one layer of dielectric resonant cavity have metal plating.
11. An electronic device, comprising the dielectric filter antenna according to any one of claims 1 to 10.
12. An antenna array, comprising a plurality of dielectric filter antennas according to any one of claims 1 to 10, wherein the plurality of dielectric filter antennas form an array in a horizontal direction and/or a vertical direction.
13. The antenna array according to claim 12, wherein the antenna array is applied to a network device.

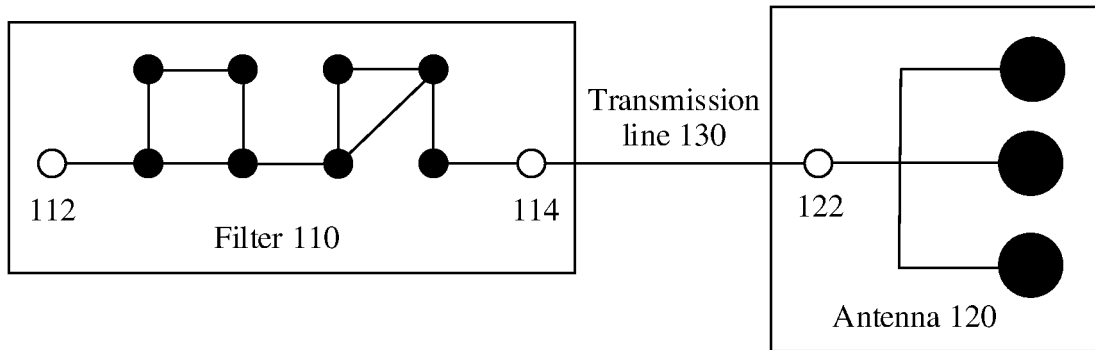


FIG. 1

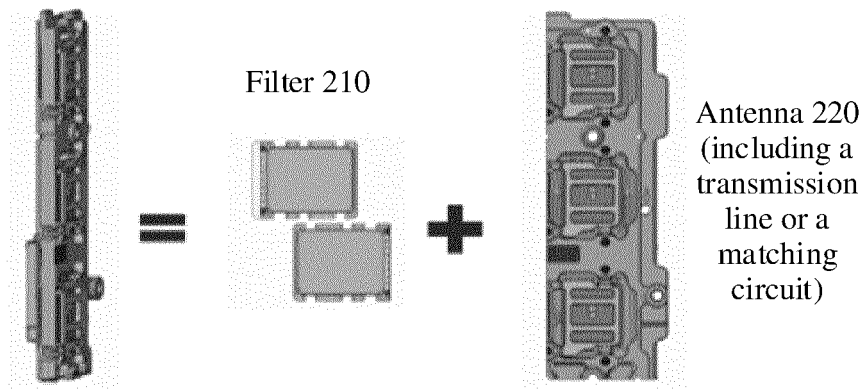


FIG. 2

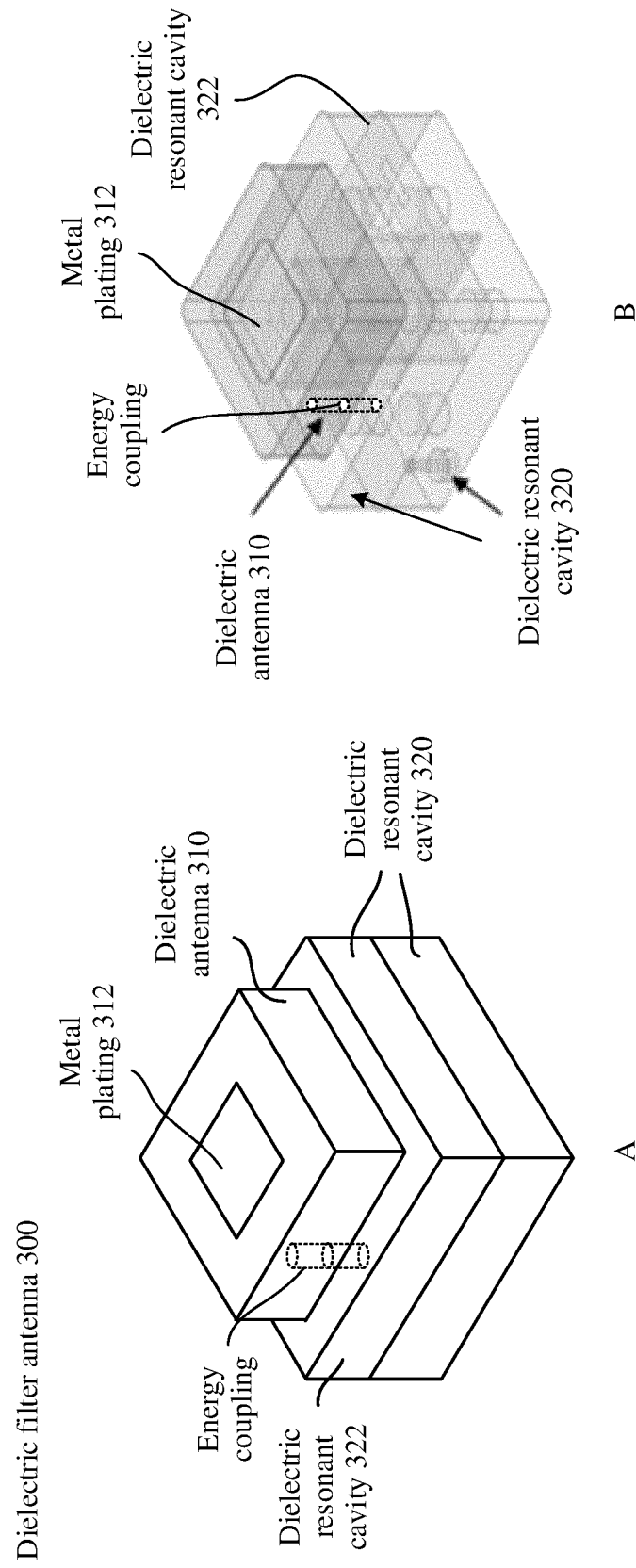


FIG. 3

Dielectric filter antenna 400

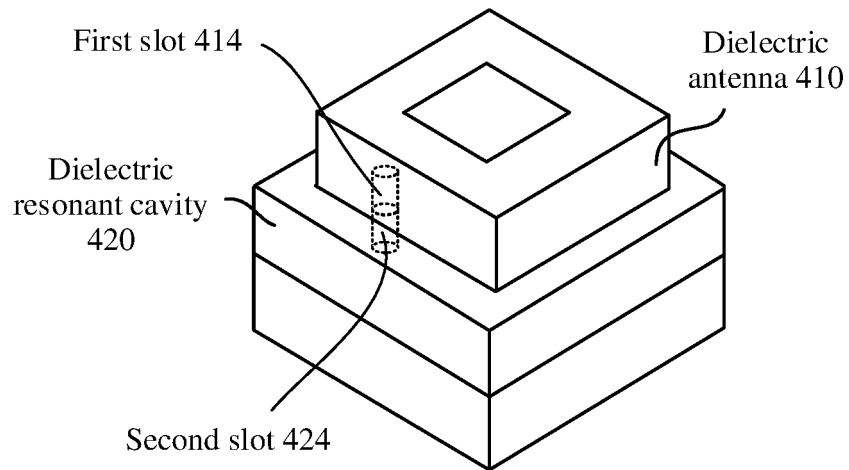


FIG. 4

Dielectric filter antenna 500

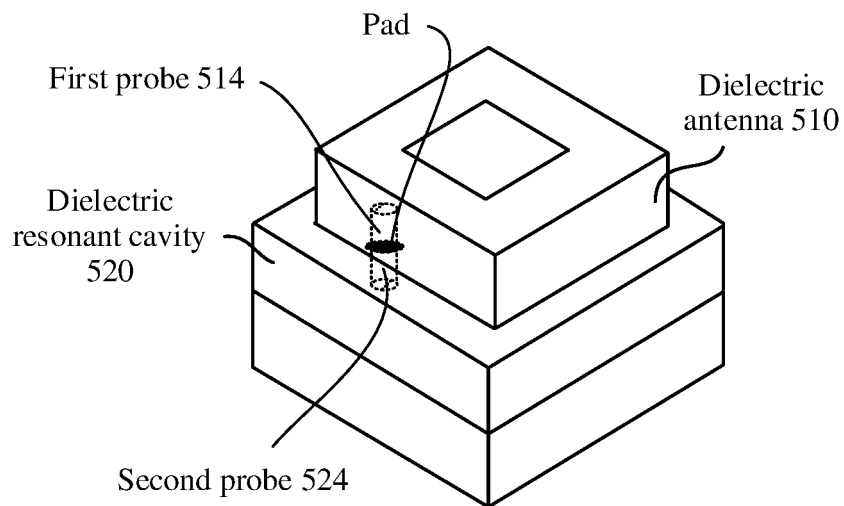


FIG. 5

Dielectric filter antenna 600

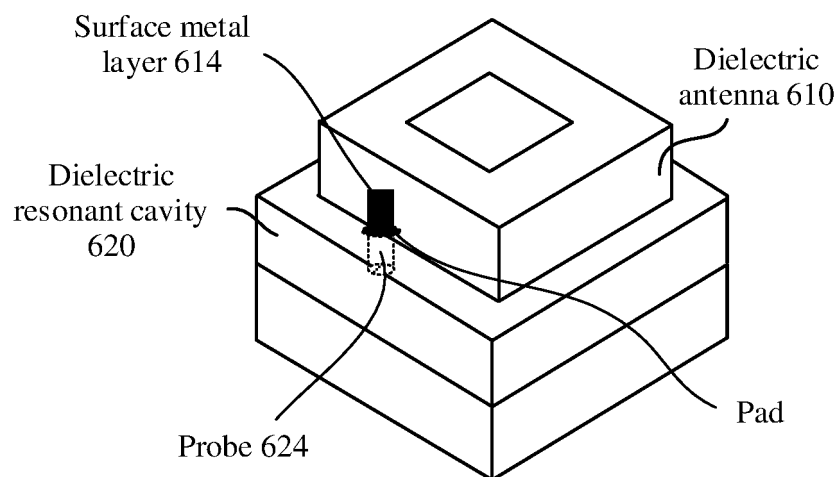


FIG. 6

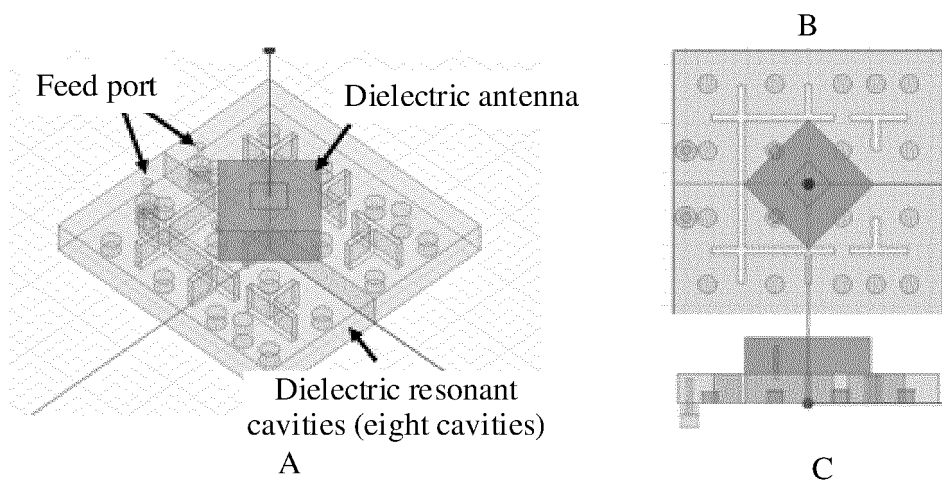


FIG. 7

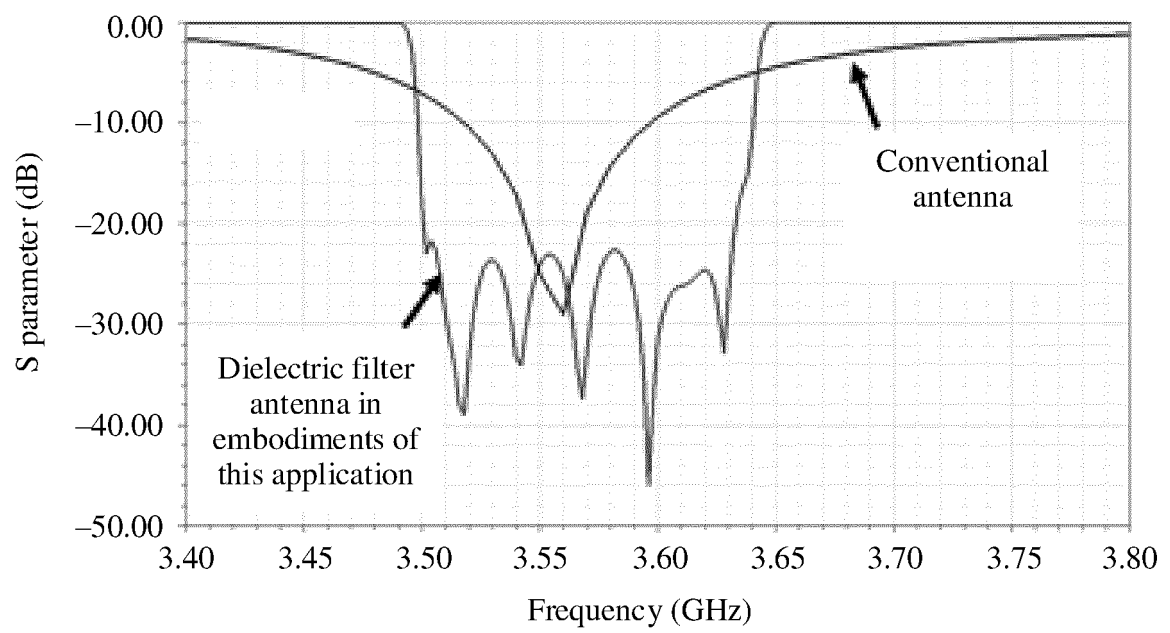


FIG. 8

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2021/102294

A. CLASSIFICATION OF SUBJECT MATTER H01Q 1/36(2006.01)i According to International Patent Classification (IPC) or to both national classification and IPC																				
B. FIELDS SEARCHED																				
Minimum documentation searched (classification system followed by classification symbols) H01Q																				
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched																				
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) CNPAT, CNKI, WPI, EPODOC, IEEE: 滤波天线, 谐振腔, 谐振器, 谐振槽, 耦合, 能量, 高, 介电常数, 陶瓷, filter, antenna, resonant, coupl+, energy, high, dielectric, constant, ceramic																				
C. DOCUMENTS CONSIDERED TO BE RELEVANT																				
<table border="1"> <thead> <tr> <th>Category*</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>Y</td> <td>付胜伟 等 (FU, Shengwei et al.), "具有高选择性的滤波天线设计 (Design of Filtering Antenna with High Selectivity)" <i>测试技术学报 (Journal of Test and Measurement Technology)</i>, Vol. 33, No. 5, 17 October 2019 (2019-10-17), sections 0-2</td> <td>1-13</td> </tr> <tr> <td>Y</td> <td>CN 110401021 A (EAST CHINA JIAOTONG UNIVERSITY) 01 November 2019 (2019-11-01) description, paragraphs 0035-0054</td> <td>1-13</td> </tr> <tr> <td>Y</td> <td>CN 105428802 A (SOUTH CHINA UNIVERSITY OF TECHNOLOGY) 23 March 2016 (2016-03-23) description, paragraphs 0034-0035, figures 1-4</td> <td>1-13</td> </tr> <tr> <td>Y</td> <td>CN 205211937 U (SOUTH CHINA UNIVERSITY OF TECHNOLOGY) 04 May 2016 (2016-05-04) description, paragraphs 0031-0039, figures 1-4</td> <td>1-13</td> </tr> <tr> <td>A</td> <td>US 2014118206 A1 (MESAPLEXX PTY LTD.) 01 May 2014 (2014-05-01) entire document</td> <td>1-13</td> </tr> </tbody> </table>	Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	Y	付胜伟 等 (FU, Shengwei et al.), "具有高选择性的滤波天线设计 (Design of Filtering Antenna with High Selectivity)" <i>测试技术学报 (Journal of Test and Measurement Technology)</i> , Vol. 33, No. 5, 17 October 2019 (2019-10-17), sections 0-2	1-13	Y	CN 110401021 A (EAST CHINA JIAOTONG UNIVERSITY) 01 November 2019 (2019-11-01) description, paragraphs 0035-0054	1-13	Y	CN 105428802 A (SOUTH CHINA UNIVERSITY OF TECHNOLOGY) 23 March 2016 (2016-03-23) description, paragraphs 0034-0035, figures 1-4	1-13	Y	CN 205211937 U (SOUTH CHINA UNIVERSITY OF TECHNOLOGY) 04 May 2016 (2016-05-04) description, paragraphs 0031-0039, figures 1-4	1-13	A	US 2014118206 A1 (MESAPLEXX PTY LTD.) 01 May 2014 (2014-05-01) entire document	1-13		
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Date of the actual completion of the international search 01 September 2021	Date of mailing of the international search report 28 September 2021																			
Name and mailing address of the ISA/CN China National Intellectual Property Administration (ISA/CN) No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088 China Facsimile No. (86-10)62019451	Authorized officer Telephone No.																			

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2021/102294

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CN	110401021	A	01 November 2019	None			
CN	105428802	A	23 March 2016	None			
CN	205211937	U	04 May 2016	None			
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				WO	2014064457	A1	01 May 2014
				EP	2912716	A1	02 September 2015

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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