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INTEGRATED ANTENNAS-FILTERS ON DIELECTRIC RESONATORS

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ІНТЕГРОВАНІ АНТЕННИ-ФІЛЬТРИ НА ДІЕЛЕКТРИЧНИХ РЕЗОНАТОРАХ

Досліджуються характеристики розсіювання нового класу пристроїв, одночасно виконуючих функції смугових фільтрів та антен, побудованих на діелектричних резонаторах циліндричної форми.

Currently, most of the developed antennas on dielectric resonators have a number of flaws, such as narrow frequency bands, the presence of parasitic oscillations, etc. [1-3]. The actual task in this area is to find new structures that will get rid of these shortcomings.

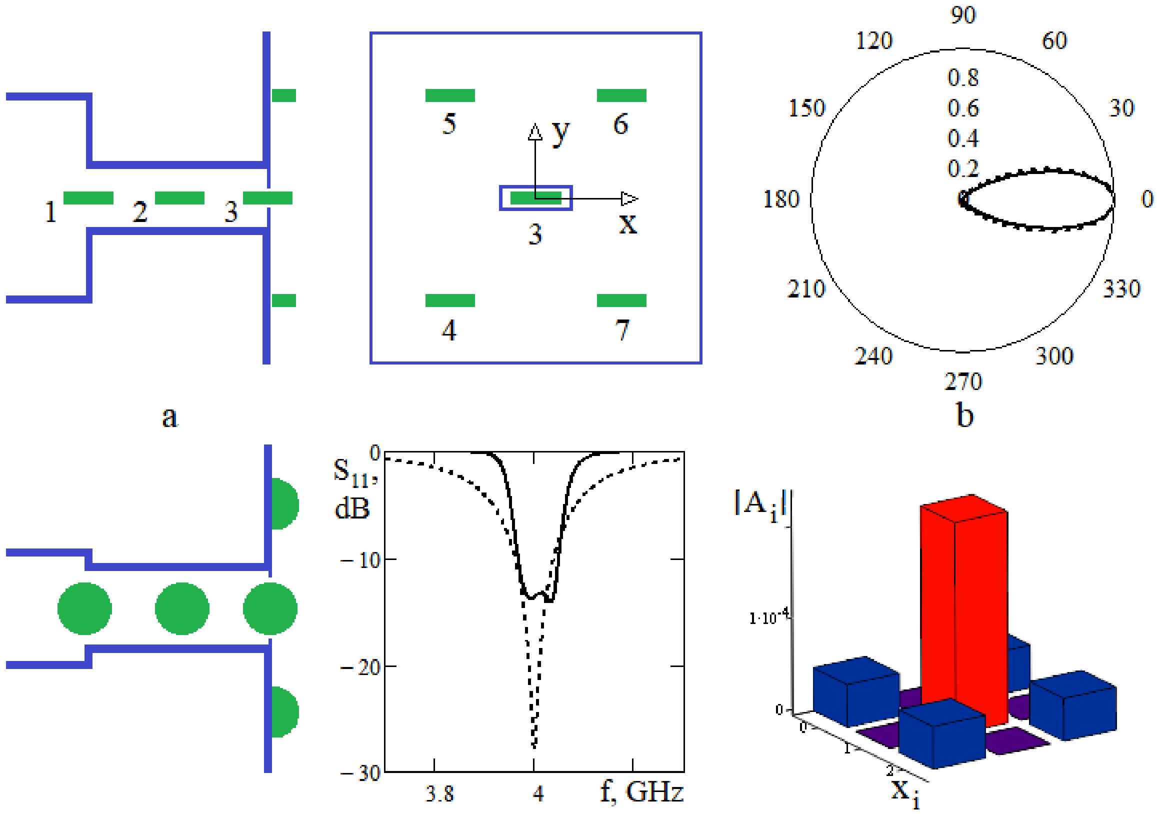

Fig. 1. Band-pass filter (1-3) and antenna (3-7) on cylindrical DRs with azimuthally symmetric magnetic modes H^{+}_{101} (a) ($\varepsilon_{1r} = 36;\ Q^{D} = 2\cdot 10^{3};\ \Delta = 0,25$). Far-field radiation pattern in the E-plane - continuous curve; in the H-plane - dotted curve (b). Reflection coefficient as a functions of the frequency (c). Module amplitude distribution of the DR 3-7 field (d).

The purpose of this report is to develop a new class of devices that combine the properties of antennas and band-pass filters made on dielectric resonators, allowing to expand the frequency bands, reduce losses, and also effectively combat parasitic oscillations.

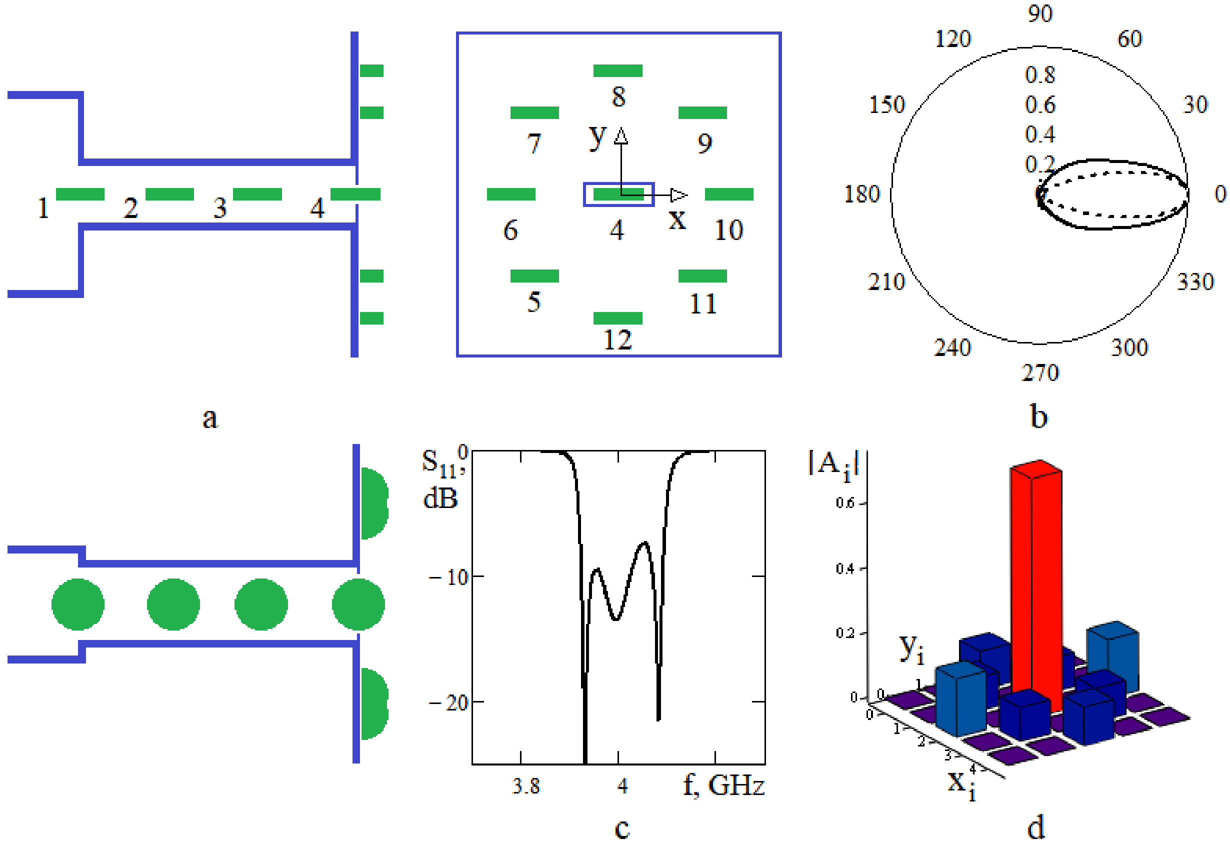

Fig. 2. Band-pass filter (1-4) and antenna (4-12) on cylindrical DRs with azimuthally symmetric magnetic modes H^{+}_{101} (a). Far-field radiation pattern in the E-plane - continuous curve; in the H-plane - dotted curve (b). Reflection coefficient as functions of the frequency (c). Module amplitude distribution of the 4-12 DR field (d).

The solution to this problem can be a structure consisting of coupled DRs, located at the same time in the beyond the cut-off waveguide and open space. In fig. 1 - 3, a shows the design of devices that simultaneously combine the capabilities of filters and antennas. Part of the resonators is located in the cut-off waveguide (fig. 1, DR 1-3; fig.2, DR 1-4, fig. 3, DR 1-3) and another part of resonators is located in the open space (fig. 1, DR 3-7; fig.2, DR 4-12; fig.3, DR 3-7). First subsystems performs the functions bandpass filter and second functions antenna. Both subsystems have at least one common DR (fig. 1, 3, DR 3; fig. 2, DR 4) are coupled together and were calculated as one complex system.

The radiation characteristics of the devices, calculated on basis of model [4], are shown in Fig. 1-3, b. The dependences of the reflection coefficient at the input of devices are in Fig. 1-3, c show a good responsiveness of the systems for the expansion of the frequency band. The distribution of the amplitude modules of the resonators in open space is shown in Fig.1-3, d.

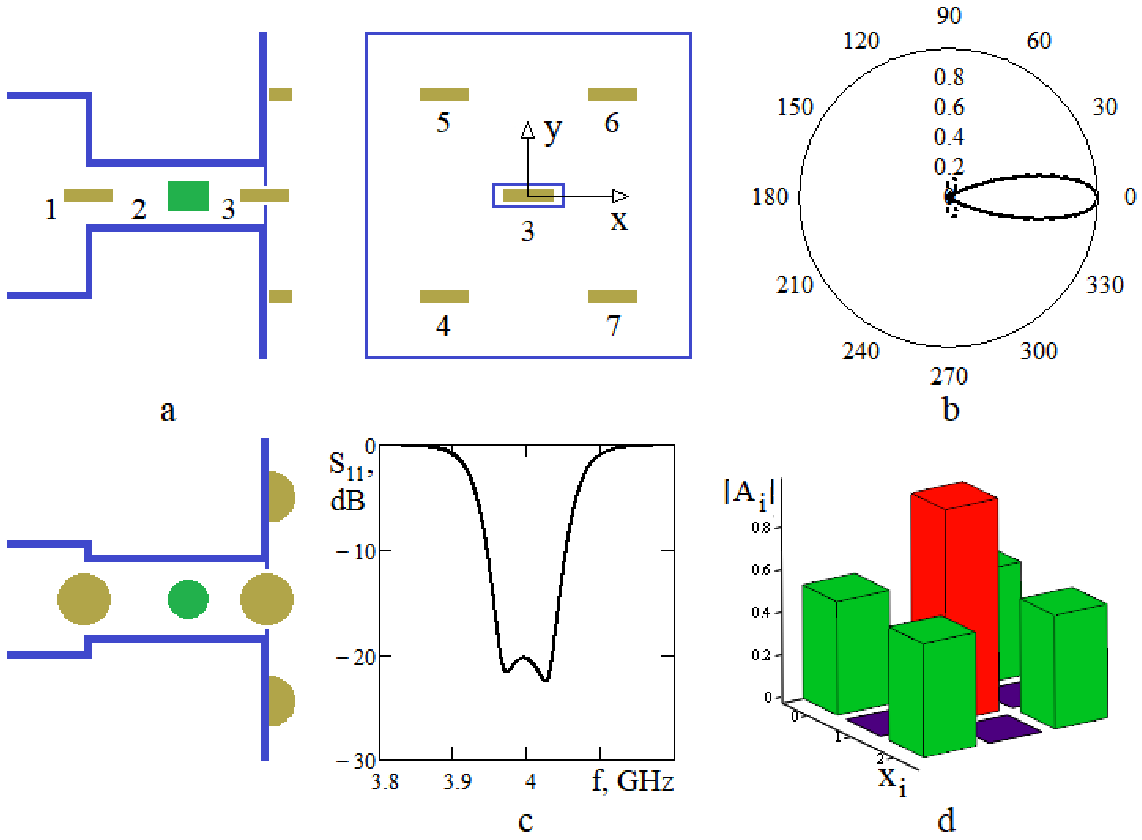

Fig. 3. Bandpass filter - antenna on different cylindrical DRs ($\varepsilon_{1r} = 36$; $\Delta_1 = 0,2$; $Q_1^D = 3 \cdot 10^3$; $\varepsilon_{2r} = 82$; $\Delta_2 = 0,5$; $Q_2^D = 1 \cdot 10^3$). Far-field radiation pattern (b). Reflection coefficient as a functions of the frequency (c). Module amplitude distribution of the 3-7 DR field (d).

As follows from the above data, the proposed design allows us effectively extend the operating frequency bands of the antennas, significantly improve their selectivity and allow to reduce losses and total dimensions. The antenna shown in fig. 3, in addition, will can also have a more sparse frequency spectrum of spurious oscillations. The compact dimensions of the proposed antenna filters make them convenient for use in base stations of wireless communication systems as well as other microwave devices.

References

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