



Editorial

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Dielectric Resonator based Multifunctional Antennas for Next Generation Communication Devices

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THE tremendous growth in wireless communication resulted exponential increase in the mobile phones density and their functionalities, this was pushed further with the advent of the Internet of Things (IoT). Multi frequency band support made them to cover important standards like: GSM (1800MHz & 1900MHz), UMTS (2100MHz), Bluetooth & Wi-Fi (2.4GHz) and LTE system (2.3GHz, 2.5GHz, and 2.6GHz), which necessitated design of ultra wide band compact antennas. Moreover, the smaller mobile phones with enhanced services increased the user ability to use the mobile phone for different applications with good performance across the world for multiple functionalities. An up-to-date literature overview is presented here to make dielectric resonator antennas (DRAs) as potential candidates for those smart wireless devices operating at millimeter waves and beyond, we also examining current trends and future scope.

Considering space limitation, port-to-port isolation or mutual effects of other elements, the conventional solution of using two or more antennas to realize multi-functionality and/or diversity schemes may not be possible with ever reducing wireless portable devices. So Micro-strip patches and dielectric resonators (DRs) are two low-profile variants surfaced for modern microwave and millimeter wave antennas. Among them two predominate solutions currently used in compact mobile communication devices are multi-ports printed diversity antenna [1] and planar inverted-F antenna (PIFA) [2] to achieve multi-functionality and diversity schemes. They are single antenna structures, which support several functions with low mutual power coupling between different ports. Both these antennas designs have advantages of compact size, low fabrication cost and low profile as desired but they usually suffer from their complicated structure, large size, relatively low gain compared to other conventional

antennas, on the other hand dielectric resonator antennas (DRAs) are promising to overcome most of the limitations. However, the DR antenna (DRA) is relatively new and still passing through the stages of development. In the beginning of 1970s, the dielectric materials of high dielectric constant (10 to 300) were used as resonant cavities for various applications like microwave filters, tuners, amplifiers and oscillators. However, the remarkable study of dielectric material as an antenna element by Long et al. in 1983 has completely changed its scope of application. The dielectric materials with permittivity values in the range 10 to 40, when properly fed will act as excellent radiators. These DRAs are available in variety of shapes like rectangular, cylindrical, spherical, hemi spherical, etc. However, depending on the requirement, the DRAs can be fabricated in different geometries. The DRAs can be excited with various feeding mechanisms like coaxial probe, micro-strip line, aperture coupling, slot, coplanar line, etc., resulting in multiband and wideband operations. The quality factor Q of these antennas will depend on the aspect ratio of the geometry to give more flexibility in the design. A low and wide dielectric resonator antenna can thus have the same resonant frequency as that of a tall and thin dielectric resonator antenna. This gives a certain degree of freedom to the designers in shaping the dielectric resonator antenna to meet specific requirements. The DRA has many advantages such as small size, light weight, low dissipation loss, high radiation efficiency and ease of excitation as well as wider impedance bandwidth as compared to micro-strip antenna. DRAs have a clear advantage over micro-strip antennas in many aspects like bandwidth, radiation efficiency, high power handling capability, etc. As the radiating element in DRA is the dielectric material, the conduction losses are minimal and thus higher antenna efficiencies can be achieved. Hence, nowadays the study on DRAs has become popular and the

researchers are further investigating the ways and means to achieve broadband /multiband support by improving their design characteristics [3]. Dielectric resonator antennas (DRA) possess some attractive characteristics which make them as very promising and affordable at microwave and millimeter wave frequencies for wireless applications especially for multiband operational needs of a single device. The 3-D structure of DRAs allows exciting various modes in one antenna volume makes feasible to design multiband or diversity DRAs using a single DR, which will reduce overall system size and cost. The desired requirements can be achieved by properly choosing the shape and modes of the DR. Several high performance multifunction DRAs have been studied and reported in the last decade. A cylindrical DR was used as filter and antenna, ultra-wideband operation was achieved by exciting the fundamental and higher-order modes in a hybrid DRA [4], a dual-band antenna with two different radiation patterns in two separate bands was achieved by using a cylindrical DRAs. In multifunction DRAs, the various modes are resonant at different frequencies, so it will be

attractive to tailor these resonance frequencies of modes to achieve overlapping frequency ranges for the different ports and thereby to realize an ultra-wideband DRA to achieve multifunction operations.

As a conclusion, DRAs have attractive features such as small size, high radiation efficiency, and versatility in their shape and feeding mechanism, various modes of excitation with diverse radiation characteristics makes them suitable as future wireless mobile antennas and potential candidate for multifunction applications at Microwave, millimeter and sub-millimeter wave frequencies where size and structure matters a lot. Thus due to several known reasons, the DRA appears to be a possible replacement for the micro-strip patch, especially at higher frequencies.

With Regards
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