NEW MATERIALS AND NANOTECHNOLOGY

TANTALUM-FREE MICROWAVE DIELECTRIC RESONATORS WITH ENHANCED QUALITY FACTOR

Description

The main problem addressed is the replacement of prohibitively expensive tantalum containing microwave (MW) dielectric materials by new cheap analogues without quality penalty. New materials and resonators will be based on inexpensive raw materials, and will be characterized by 2-5 times lower production costs, compared to currently available high-Q materials which include hard-to-process polycrystalline Al_2O_3 and prohibitively expensive Ta-containing perovskites $Ba(M^{2+}{}_{1/3}Ta_{2/3})O_3$. This will allow a significant economical benefit for the applications in communication apparatus.

The implementation of new, cheap, high-Q DRs in the modern MW communication systems and devices including equipment for high-selectivity collision avoidance radars, intelligent transport systems, third-generation (3G) and eventually (4G) base-stations, secure frequency channels for local communication systems, etc will allow an enhancement of the security of the wireless data transmission as well as make safe solutions more affordable to our society.

Innovative Aspect and Main Advantages:

The implementation of new materials and resonators for frequency selection, separation, and filtering devices would result in the following benefits:

(a) substantial enhancement of the performance parameters of microwave equipment, and hence, its higher reliability, selectivity, and protection against unauthorized access;

(***b***) significant reduction of the production costs in contrast to the current tantalum containing low-loss materials. The combined effect of the above two factors would consequently afford safer and more reliable wireless data transmission in both Partner and NATO countries

The joint work of the research teams has focused on both *scientific* and *engineering* substantial benefits:

- New low-cost low-loss MW dielectrics ($Q \times f \geq$ 100 000 GHz) with good temperature stability of the dielectric constant (τ_ε= - 10 to +10 ppm/K) will be developed to replace highly expensive barium tantalates and hard-to-processing alumina-based materials.
- New MW components and devices including DROs for the frequencies of up to 40 GHz with the low phase noise (up to –120 dB at 1 KHz offset from the carrier frequency), ultra narrow-band filters and diplexers with the relative BW of 0.3 to 0.5 % and 0.5 to 1.0 % for the 3-5 circuit design, low insertion loss in the BW (<1dB), and excellent rectangularity within the BW.
- Microwave devices developed will have significant advantages in comparison with the currently available analogues, namely they will demonstrate higher performance due to their original design and low-loss materials used.

Areas of Application:

New materials and resonators will be utilized in the Microwave engineering as the passive components for the MW oscillators (DROs), low phase noise MW amplifiers and high selectivity filters and duplexers. as well as dielectric substrates and antennas.

Fig.1 Dielectric Resonators

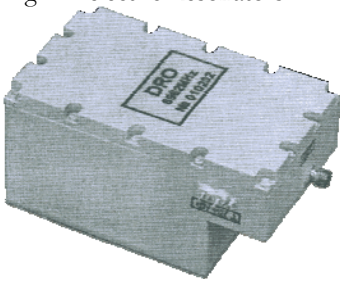

Fig.2 Low-noise MW oscillator

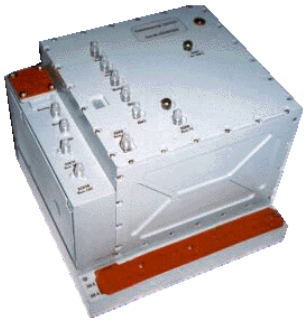

Fig.3 Frequency Synthesizer

Stage of Development:

The research is currently under way: Development phase Technology transfer and cooperation for further development are sought.

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