KCA Elements in Electromagnetically Metamorphic Objects and Interfaces

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ABSTRACT

The concept of KCA (Kyriazidou Contopanagos Alexopoulos) generators [1,2] is used to create objects and material interfaces which exhibit significantly different characteristics with an interacting electromagnetic wave. A new microtechnology of RF MEMS is adopted to produce integrable switches into KCA implant elements. This allows the creation of variable PBG structures of reconfigurable space filters, polarizers, and materials amongst several other applications.

KCA elements and RF MEMS in PBG structures

The relationship of the classical and quantum representation of polarizability is reviewed and it is used to justify the use of KCA generators [1]-[4] to create practical PBG implant elements is considered and a catalogue of their intrinsic properties is presented in terms of the effective parameters of the resulting PBG structure. The effective parameters include index of refraction, permittivity, permeability, and impedance.

KCA generator can be treated by both the classical theory [3] and the quantum theory [4]. KCA generator is interpreted as a damped harmonic oscillator in the classical theory, and treated as a bounded electron transferring between separated energy levels. KCA generator is used to derive other effective parameters for the final PBG structures with KCA implant element [1]. The KCA generator satisfies the Kramers-Kronig relation and causality principle [4]. This is very important when we try to interpret the effective parameters.

Author [1] embedded the metallic disk in dielectrics with finite loss and realized the artificial Lorentzian type media from very low frequency to microwave range. Some results are shown in the figure 1.

Our presentation also focuses on the use of our RF MEMS microtechnology which we use to create reconfigurable implants. The RF MEMS switch is fabricated using our technology which allows the switch to be fabricated directly on a printed circuit board [5].

Figure 1. Band structure and Lorentzian for the metallic implant PGB structure. Both graphs are calculated according to Ref. [3].
The process starts with a RO4003 substrate, a high performance laminate, $\varepsilon_r=3.38$, with $\tan\delta=0.0027$, and copper layers of 17 mm and dielectric thickness of 1.5 mm, because of its relatively low cost and capability to handle high frequencies up to 18 GHz. A coplanar waveguide (CPW) structure with 230 mm-width and 35 mm-gap is formed by patterning and wet etching the top copper layer to obtain a 50 W-transmission line. Afterwards, the membrane post are patterned and electroplated for 5 mm thick Cu at the ground plane of the CPW. These posts are used to define the air-gap between the membrane and the CPW signal line.

![A fabricated asymmetric switch with membrane at down-position.](image)

A 200 nm silicon nitride film is then deposited on the signal line and on the membrane posts by a low temperature high-density inductively coupled plasma chemical vapor deposition (HDICP CVD) [6][7]. After deposition, the SiNx film is lithographically patterned by a different mask and selectively removed by reactive ion etch (RIE).

The compression-molding-planarization (COMP) process is applied to planarize the highly topographic photoresist surface and thus to ensure mechanical integrity of the membrane to be deposited. Following the planarization, the sacrificial photoresist layer is then lithographically patterned for the metallization step. An aluminum film is deposited on the surface and patterned to form the switch membrane. The sacrificial layer is removed to release the membrane in the final process step. Fig. 2 shows the fabricated asymmetric switch with membrane at the down-position.

We initially use this microtechnology to generate closed and open metallic ring implants, thus create significant reconfigurability for all effective parameters between the closed and open states of the rings.

**Conclusion**

A review on the KCA generator and the RF MEMS switch has been presented. The combination of the Lorentzian media and novel RF MEMS technology enable us to extend the usage of artificial Lorentzian material in the antenna, circuit and signal processing areas.
REFERENCE