METAMATERIAL RESONATOR ANTENNAS

Opportunity:

These metamaterial resonator antennas are for mm-wave and sub mm-wave applications. This technology provides a framework for tailoring electromagnetic properties of an engineered material using low temperature photoresist base processes, providing special performances that is not possible with natural materials, such as controlled inhomogeneity, multiport performance, multiple close broadside radiation modes, to name a few.

- **Ease of Fabrication**
- **Electromagnetic Tailoring**
- **Multiple Applications**
- **Ideal for Embedding**

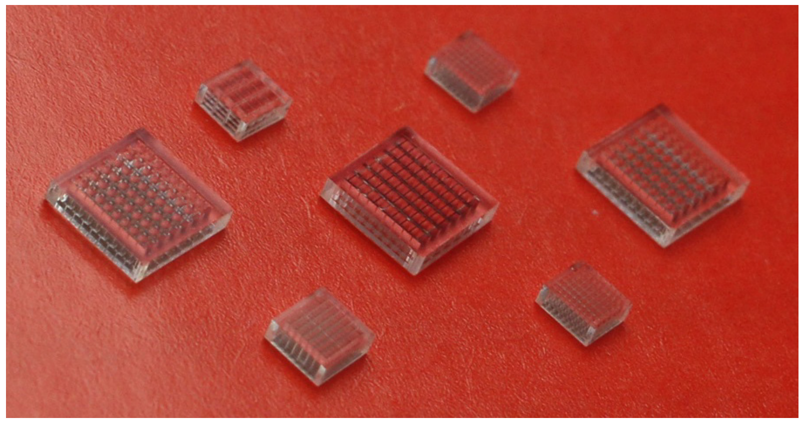

Figure 1. Photograph of a set of lithographically fabricated artificial resonator elements with different sizes and various embedded grids. *

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Development Stage:

Measurements performed in sub-mm and mm wave bands. Numerous prototypes including arrays are fully developed.

Patent Status:

PCT - Metamaterial Resonator Antenna. Filed 31 Jan 2013

Reference#: ROI 12-034

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For more information please check the group's latest paper.

Invention: The invention presents engineered artificial dielectric resonators with embedded metal grids of various geometries and configurations (Fig. 1). Such artificial materials not only benefit from enhanced effective permittivity (up to 6 times), but also have unusual near field distributions with properties that could be especially beneficial when used as radiating structures. *Metamaterial Resonator Antennas* are fabricated using polymer-based materials, such as those commonly used in lithographic fabrication of integrated circuits and microsystems. The artificial radiators can therefore be fabricated using standard lithography methods, instead of extremely high temperature sintering processes that are needed for the standard ceramic resonator antennas. The antennas have metal inclusions embedded in the resonator body which can be configured to control electromagnetic field inside the elements, which serves to enhance the effective permittivity of the resonator body, while providing a lot of novel effects, usually not possible with natural materials that can be used in numerous applications. For example, the novel close radiating modes are different than the electromagnetic modes inside normal dielectric resonators, and they can be used to make multi-mode antennas with significant reduction in size, including the size of the ground plane. Also, creating an anisotropic material with different effective permittivity and polarizations in different orientations is possible and can be used to produce embedded multi-port antennas with high input isolation. Summary of the performance of the metamaterial resonator antennas can be seen in the following figures.

Fig. 2

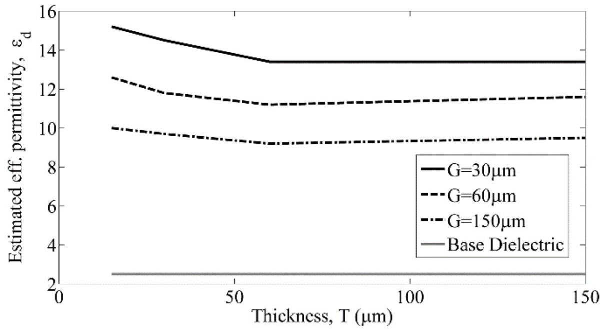

Figure 2. Permittivity estimation of the artificial dielectric with different grids. The overall effective permittivity can be up to 6 times more than the base polymer material. *

Fig. 3

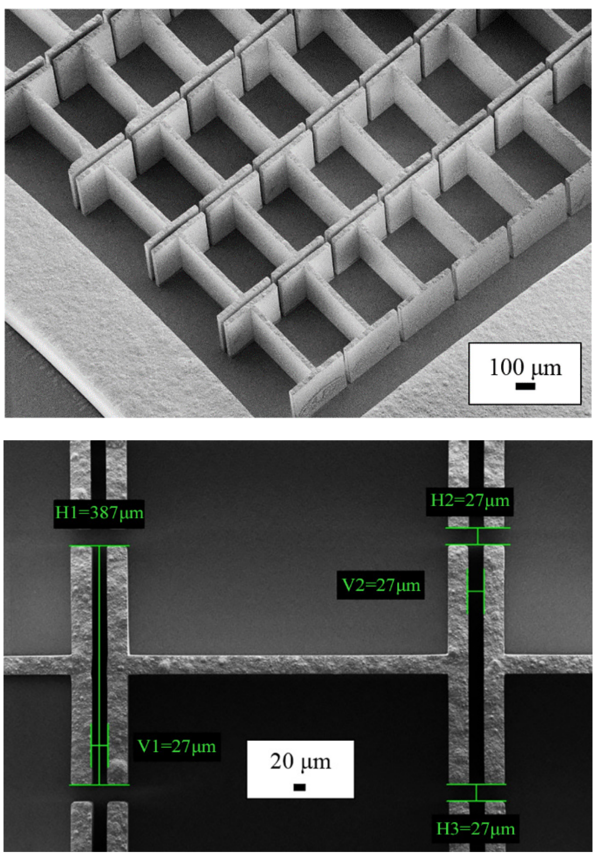

Figure 3. SEM micrographs of the GDRA metal grid and individual inclusions after metallization. The overall grid is shown in the top picture, the bottom shows close-up of inclusions. *

* M. Tayfeh, D. M. Klymyshyn, et al. "Investigations on Photoresist-based Artificial Dielectrics with Tall Embedded Metal Grids and Their Resonator Antenna Application", IEEE Transaction on Antennas and Propagation, Vol. 63, No. 09, 2015.

Fig. 4

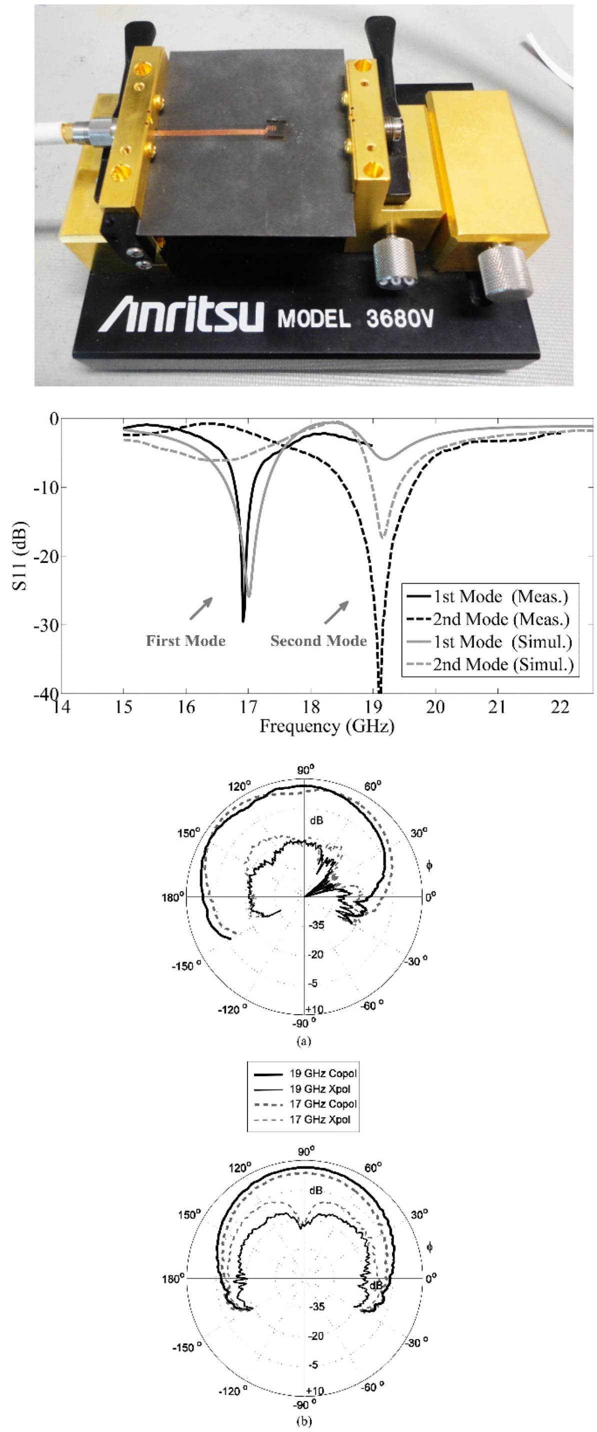

Figure 4. Measurements of metamaterial resonator antennas. Measurement setup (top), Frequency response of different modes (middle), and radiation patterns. *

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