IIT MADRAS
Indian Institute of Technology Madras

Technology Transfer Office
TTO – IPM Cell

Industrial Consultancy & Sponsored Research (IC&SR)

Asymmetric Phononic Crystal (PnC) Tethering for Radio Frequency (RF) Micro-electro-mechanical System (MEMS) Resonator

IITM Technology Available for Licensing

Problem Statement

- Current resonators suffer **Low Q-Factors** and **higher insertion losses,** due to **anchor losses, interfacial dissipation, & material losses** in electrodes.
- Acoustic waves escaping through support tethers **reduce the energy retention** in resonators, **impacting overall performance**.
- Existing symmetric Phononic Crystal **(PnC)** designs shows a lot of drawbacks, prompting **the need for an improved structure to contain acoustic wave leakage effectively.**
- Hence there is a need of this instant patent disclosure to address above mentioned issues.

Technology Category / Market

Categories: Photonics | Electronics & Circuits | Chemistry & Chemical Analysis

Industry: MEMS Resonators, RF components & Phononic Crystals, Semiconductor & Electronics Manufacturing, Integrated & Standalone Devices

Applications: Wireless Communication Devices, Sensors and Measurement Equipment, 5G, IoT, Telecommunication Infrastructure, Advanced Research Instruments, Automotive, Consumer Electronics, Frequency Control Devices

Market: The MEMS resonator market is expected to grow from **$ 2.4 Mn** in **2021** to **$ 4.9 Mn** by **2028**, at **8.23% CAGR** from **2022 to 2028.**

Technology

The present patent discloses **an asymmetric Phononic Crystal (PnC) tethering for Radio Frequency (RF) Micro-electro-mechanical System (MEMS) Resonator**, comprises:

- **Two asymmetric unit cells including semicircular inclusions.**
- **The center of each semicircular inclusion is displaced from each other by a distance 2d.**
- **Each said asymmetric unit cell is repeated in same direction with a lattice constant 'a'.**
- **The asymmetric unit cells with the lattice constant 'a' undergoes elastic waves scattering in the semicircular inclusions.**
- **The PnC tethering is attached to a resonator using a tapered connector.**

TRL (Technology Readiness Level)

IITM IDF No: **1337 |** IP No.: **392423 (Granted)**
PCT No.: **PCT/IN2017/050017**

Intellectual Property

TRL - 4, Experimentally validated in lab.

Research Lab

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Key Features / Value Proposition

❖ ***User Perspective:***

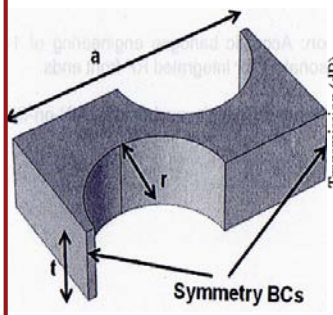
- Enhanced Device Performance
- Stability and Precision & Seamless Connectivity

❖ ***Industrial Perspective:***

- Competitive Advantage & Cost-Efficiency
- Reliable Wireless Communication Devices Across Consumer Electronics, Automotive, & Telecommunications Industries.

❖ ***Technical Perspective:***

- High Q-Factor Improvement
- Customizable Design with smaller size
- Integration Potential
- Effectively addresses anchor losses in MEMS resonators, leading to a significant improvement in the resonator's Q-Factor.
- By containing acoustic wave leakage, it retains more energy in resonator, boosting its overall performance.



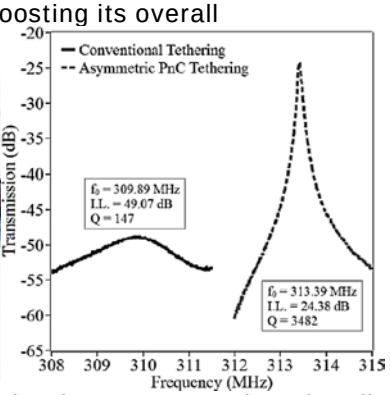


FIG. 1 shows a schematic of an asymmetric unit cell for an asymmetric one-dimensional PnC tethering
FIG. 2 is a graph showing a comparison between measured response of resonators with conventional tethering and asymmetric PnC tethering

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