

S&T Campaign: Materials Research

Electronics

MEMS

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Research Objective

Explore MEMS technology solutions to enable frequency agile components for cognitive RF systems including tactical radios, next generation radar, and EW systems.

Devices to Enable Reconfigurability

Switches
Resonators
Varactor Inductors
Filters

Electro-mechanical Modeling & Design

— Resonator Data Unmatched
— Resonator Data Matched
— Ideal Resonator Matched

— Model
— Experimental

Tunable k^2
Tunable k_{33}

Materials and Fabrication

Displacement (μm) vs Voltage (V)

Lotgering Factor (%) vs O_2 Flow (sccm)

Challenges

- Integration with CMOS and high aspect ratio metal MEMS processes
- Novel processing methods such as 3D conformal deposition techniques (e.g. ALD) and multi-layer piezoelectric stacks
- Tunable, frequency agile components and controlling substrate loss effects
- Integrated wafer level packaging

ARL Facilities and Capabilities Available to Support Collaborative Research

- Specialty Electronic Materials and Sensors Cleanroom (SEMASC) 15,000 ft² fabrication facility
- Only open R&D facility in US with full suite of piezoelectric material deposition, fabrication, device modeling, and characterization infrastructure and expertise
- RF MEMS characterization laboratory including vector network analyzers (~30 kHz to 67 GHz), spectrum analyzers, and semi-automated probe stations (with integrated temperature controlled wafer chuck)
- MEMS actuator characterization laboratory (high speed video, laser doppler vibrometer (DC to 1.2 GHz), probe stations, etc)



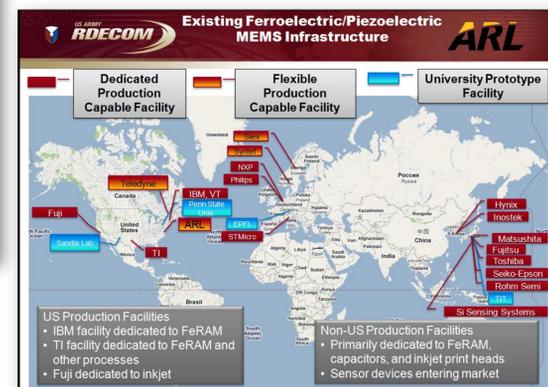
Automated CSD & Sputtering



Endpoint Assisted Ion-Milling and Reactive Ion Etching



Semi-Automated Probe Station with thermal chuck and with access to VNAs, ARBs, power supplies, and a laser trimming system



Only flexible production capable facility in US

Complementary Expertise/Facilities/ Capabilities Sought in Collaboration

- RF MEMS Design and Characterization
- Advanced MEMS Packaging (wafer level and heterogeneous)
- System level integration