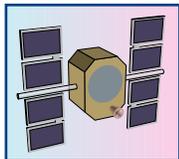


NOVEL FERROELECTRIC MATERIALS FOR MICROWAVE APPLICATIONS

The U.S. Army Research Laboratory (ARL) is working to develop novel barium strontium titanate (BST) based ferroelectric materials for discrete and integrated microwave applications such as fire control radar, smart munitions and point to point communications. Tactical and communication radars are key elements for "hit avoidance" in warfare. Of particular interest to the Army are Electronic Scanning Antennas (ESA). ESAs provide rapid scanning capability, which enables modes such as multiple target tracking, track while scan and sensor fusion operation.

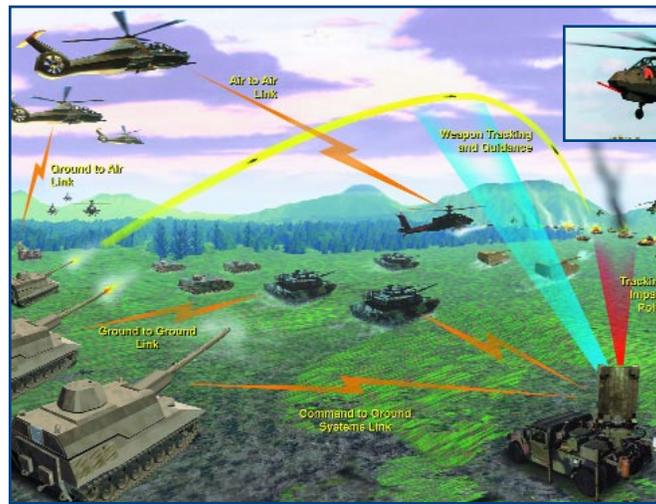
battlefield communications



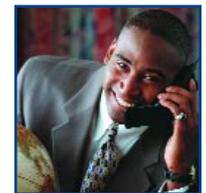
satellite communications



firefinder radar system



electronic scanning antenna for Comanche



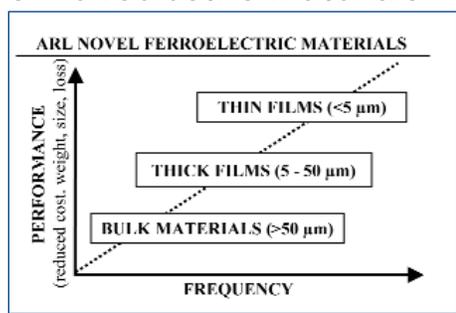
cellular communications



conformal helmet-mounted antennas

Approach

Multi-Process Synthesis of Ferroelectric Materials



Materials Fabrication

- Bulk Ceramic and Thick-Film Fabrication
- Thin-Film Fabrication
 - Metal Organic Solution Deposition (MOSD)
 - Pulsed-Laser Deposition (PLD)
 - RF-Sputtering
 - Metal Organic Chemical Vapor Deposition (MOCVD)
 - E-Beam Evaporation

Design of Devices and Antenna Systems

- Material Performance
- Materials Improvement
- Reliability Studies

Applications

Military Applications

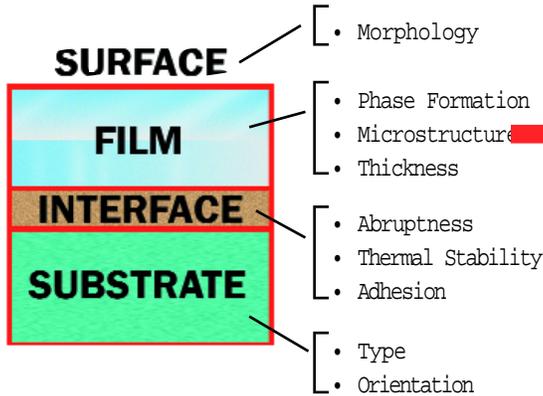
- Individual Soldier Tracking Systems
- Battlefield Communications
- Missile Seekers
- Vehicle Tracking Systems
- Active Protection Systems
- COMM-on-the-Move

Commercial Applications

- Collision Avoidance
- Satellite Communications
- Sensors
- Cellular Communications
- Internet-in-the-Sky

Thin Film Materials Development

Film-Interface-Substrate



Processing

Processing Composition, Method & Parameters

- Composition
Ba/Sr, dopant
- Physical Techniques:
PLD, Sputtering
- Chemical Techniques
MOSD, MOCVD
- Metallization
Techniques
Sputtering, E-Beam

Post Deposition Annealing Treatment: Method, Ambient

- Furnace
- RTA
- Atmosphere (O_2 , etc)

Measurements

Dielectric Properties

- $\tan \delta$, Tunability,

Mechanical Properties

- Stress, Adhesion, Cohesion

Electrical Properties

- Leakage Current (I_L)

Optical Properties

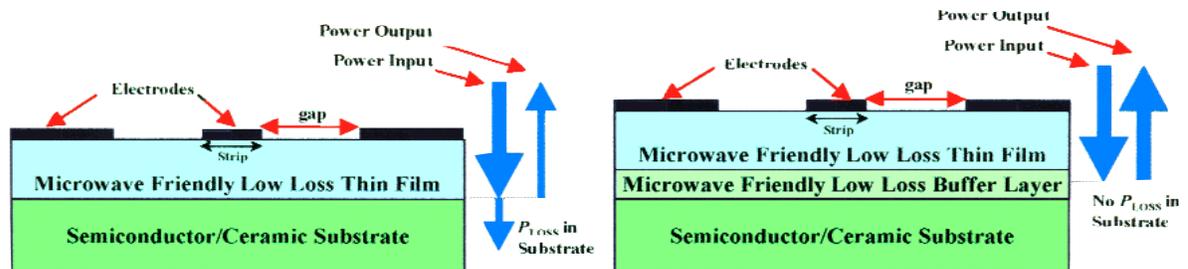
- n , k , E_g , Optical Dispersion

Reliability Measurements

- Bias Stability
- tunability drift
- Temperature Stability
- loss, tunability,

TCK

Barrier Materials Development for Integration with Si Technology



Other Applications for Ferroelectric Thin Film

NON-VOLATILE
MEMORIES

INTEGRATED OPTIC
TIR SWITCHES

DIELECTRIC
BUFFER LAYERS

DIELECTRIC
CAPACITORS

MICROWAVE
PHASE SHIFTERS

DISPLAYS
E/O

PYROELECTRIC
SENSORS

PIEZOELECTRIC
RESONATORS

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