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Do you know ME

Chengdu, Sichuan

Me in UESTC
Do you know ME

Dept. of Wireless Components

Dept. of Material Science & Engineering
Dept. of Microelectronics Science & Engineering

School of Microelectronics and Solid State Electronics
(ME)

Sch. of Information Material Engineering
Dept. of Microelectronics Science & Engineering
Do you know ME

History

Prof. Rodinski
The Former USSR

Prof. Junye Mao
The first dean

Prof. Xingbi Chen
Academician of CAS
Do you know ME

2006.07 Approved by Ministry of Science and Technology of China

2003.05 Arrange for the State Key Lab

Ministry key Lab of novel sensors
Ministry key Lab of power semiconductors
Ministry key Lab of information materials

2000.8
2000.9
2000.9
Organizations of ME

Teaching Institutes

- Department of Electronic Science & Technology
- Department of Microelectronics Science & Engineering
- Department of Applied Chemistry
Organizations of ME

Research Institutes

State Key Laboratory of Electronic Thin Film & Integrated Devices

Designer Training Base of National Integrated Circuits design

Ministry of Information Industry Key Laboratory of Electronic Information Materials

Ministry of Information Industry Key Laboratory of VLSI Design

Institute of Microelectronics of UESTC

Chengdu Industrialization Base of National Integrated Circuits Design

Ministry of Education Center of Stealth Technology and Materials Engineering

Ministry of Information Industry Key Laboratory of Power Devices and Intelligent Power Integrated Circuits

Center of Electronic Information Materials & Devices of UESTC

VLSI Design Center of UESTC
Faculty in ME

- Member of Chinese Academy of Sciences, 1 person
- Winner of Foundation of National Outstanding Youths, 4 persons
- Professor of Cheung Kong Scholar Program, 5 persons
- Innovation Team of Ministry of Education, 1 team
- Selected by the Program of Century- Spanning Talents of Ministry of Educated, 5 persons
- Academic Pioneers of Sichuan Province, 5 persons
- Supervisors of PHD Candidates, 22 persons
- Professors, 50 persons/Associate professors or senior engineers, 50 persons
- Persons holding doctor degree, 103 persons (58.2%)
- Persons with age under 58, 89 persons (86%)
Faculty in ME

Professors of Cheung Kong Scholar Program

Huaiwu Zhang  Yanrong Li  Qiang Xiao  Yuan Lin  Longjiang Deng
Disciplines & Majors

- **Two First-Class National disciplines**
  - Electronic Science and Technology
  - Material Science and Engineering

- **One National key discipline**
  - Microelectronics and Solid-state Electronics

- **Four doctoral degree authorized programs**
  - Microelectronics and Solid-state Electronics
  - Electronic Materials and Devices
  - Materials Physics and Chemistry
  - Materials Science

**Enrollment: 30 persons/year**
Disciplines & Majors

- **Six master degree authorized programs**
  - Material Science and Engineering
  - Microelectronics and Solid-state Electronics
  - Materials Physics and Chemistry
  - Materials Science
  - Electronic Information Materials and Devices
  - Applied Chemistry

  **Enrollment: 340 persons/year**

- **Two post-doctorial programs**
  - Electronic Science and Technology
  - Materials Science and Engineering
Six undergraduate programs:

- Electronic Science and Technology (Microelectronic technology)
- Electronic Science and Technology (Solid-state electronic engineering)
- Integrated Circuit design and Integrated System
- Applied Chemistry (Nano electronic materials)
- Microelectronics
- New Energy Materials and Devices

Enrollment: 600 persons/year
Research Orientations

- System - on chip
- Device – lamellar
- Material - film
Research Orientations

Power Devices and Integrated Circuits

- Power Semiconductor Technology
- VLSI Design

Electronic Information Materials and Devices

- Nano-electronics Functional Film Materials & Devices
- Novel Electronic Ceramic Materials & Devices
- Magnetic Information Functional Materials & Devices
Research Orientations

Applied Chemistry
- Printed Version of Circuit Technology
- Organic Polymer Materials & Application

New Energy Technology
- Solar Cells Technology
- Accumulator Battery & Application
- Electronic Technology of Electric Automobile
Highlights

(1) Power Electronics

- Rail transit, smart grids and white goods
- National key projects and high tech plans
- Extending from microelectronics to electronic industry

International frontier

- High voltage power IC
- LED lighting driver
- Wide $E_g$ semiconductors
Highlights

(2) Single Crystal Garnet for Microwave/Magneto-optical Application

- GGG Crystal with diameter of 82mm
- 4’ GGG substrate in epitaxial grade
- 4’ YIG films

- Technology In the first rank of the world
- The only LPE production line for large size YIG films in China

Switch, Modulator, Isolator, Circulator
MSSW devices: Modulator, Delay line, Isolator for Radar, ignition delay, and optical communication
(3) Novel Electronic materials and devices

LTCC Passive Integrated SIP Technology

Small, multi-functional and low-loss devices

A series of new structure and new devices
Highlights

(4) Information films and Integrated Devices

- Ferroelectric Film Device
- Ferromagnetic Integrated Devices
- Dielectric Multifunctional device

International frontier

- National innovation Research Group
- Major S&T projects
- 973” and “863” projects

3D Integrated Microsystem
Research Environment

- Film deposition Platform
- IC design Platform
- Micro-lithography
- Testing Platform

Lab area more than 4000m²,
Equipments valued 80 million

National 211 / 985 Project
Engineering Center of Stealth Materials and Magneto-Electronic Conformal Devices

Research Areas

Stealth Materials
Magneto-Electronic Devices
Structural Mater For Aerospace
Novel Functional Devices

National Engineering Center

Ministry of Education Engineering Center

Function, Structure conformal

Key Projects

Jumbo Jet Passive Integrated SIP
(1) Testing platform

Including micro-structure analysis and macro-characteristics test instruments, such as SPM, XRD, SEM, TEM, Faraday Loop Tracer, Quantum Interferometer, etc.
(2) Fabrication platform

Including the Fabs for microwave, millimeter wave and infrared wave stealth materials, functional magneto-electric devices, conformal devices, thin film material and devices
International S&T Cooperation Base Single-Crystal Mater for Microwave Communication

Authorized By Ministry of Science and Technology, Nov. 2009.
Growth of Crystals for Communication, Electronic, Energy, etc.
1) Production Line for Large-Size Crystals

(Only after Russia/Ukraine, Japan, German, USA)

- Imported from Russia/Ukraine and built in 2008
- 4’ GGG crystal (30cm in length), 50 pieces/year
- 3’ YIG based garnet wafer, mass production
(2) Cutting - Polishing – Testing Equipments

1. Cutting & Polishing
2. Testing & Analyzing
3. Basic Physics
(3) Production Line for LTCC/LTCF devices

1. Flow casting equipment
2. Protection film
3. Screen printing
4. LTCC stacking
5. Isopressing equipment
6. Cutting
7. Packaging
8. Weaving equipment
National Key Lab of Electronic Films and Integrated Devices

- **New Energy Technologies**
  - Power control and conversion technology
  - MR based electronic motor and power device
  - Lithium-ion battery
  - Solar Cell technology

- **Printable Electronics**
  - New Material for PCB
  - Full-automatic Equipment
  - PCB Fabrication
  - SIP Integration platform

UESTC cell-driven vehicles

Printable SIP module
Achievements

- 973 Project: THz sources, detector and Applications, 2007, 36 million RMB
- 973 Project: Dielectric/Semiconductor integrated electronic films, 2007, 20 million RMB
- “HeGaoJi” Project: Digit based RF/Power integrated Technology, 2009, 21 million RMB
- “HeGaoJi” project, 2009, 50 million RMB
- Project from Education Ministry, 2006, 12.4 million RMB
- Project from Science and Technology Ministry, 2008, 10 million RMB
Awards and patents

Awards

- National (6 items)
- Province/Department
  - First prizes 6 items
  - Second/third prizes 24 items

Patents

- 97 Chinese Patents
- 4 USA patents
- 60 in Pending

- 2010
- 2008
- 2008
- 2007
- 2005
- 2003
A novel voltage-proof layer & full-compatible power devices

- In order to solve the voltage-proof problem of high power devices, a special PN junction structure for voltage-proof layer is invented, and its producibility is realized.
- “This technique is a millstone of power semiconductor, which breakthrough the theory limitation of conventional power devices,” --- From a senior engineer of Siemens at IEDM 98’
- US patent, 2 items national awards

Cited more than 200 times in other US patents

The US Patent  Chips
large area high-temperature superconductivity
two edged Film and Microwave Devices

Focus on the difficulties of oxidation film epitaxy growth, a novel sputtering technique with uniaxial drive and biaxial rotation is invented, which can realize both homogeneity in planar and uniformity in two face of the large area YBCO high-temperature superconductivity film simultaneously.

Critical current density > 2 MA/cm² (77K)
Microwave surface resistance < 1mΩ (10GHz, 77K)

60 publications in JAP, Physica.C, IEEE, JVST and cited 102 times

Substrate biaxial rotation Technology
2-3 inch films
High Sensitive Receiver Front
Low consumption power ferrites and Ferroelectronic-ferromagnetic materials

- New theory and technology to realized low-loss power ferrites at high frequency, with $f=0.5\sim2$ MHz, $\mu\sim1500$, power loss $\sim130$ mW/cm$^3$.
- The properties of our ferrites close to PC50 (TDK, Japan), N49(Siemens, German), and 3F3 (Philip, Holland).
- 350 million profit when composite ferrites applied into LTCC technology, passive filter and switch power supply.
- National award in 2005
Nano ferromagnetic materials and its applications

◆ Developed new technology to increase the dielectric constant and temperature stability. The product is better than that of the Ferro Company, USA

◆ Developed new technology to control the interface structure. By this technology the electronic properties of oxide films (BST, PZT, etc) have been significantly improved;

◆ The improved films have been applied to three novel devices (microwave, pyroelectricity and memory)

\[
\begin{align*}
\varepsilon: & \quad 4500 \pm 700 \\
\text{Temperature}: & \quad \Delta C/C \leq \pm 12\% \\
& \quad (-55^\circ C \sim +125^\circ C) \\
\text{dielectric loss angle tangent}: & \quad \leq 1.0\% \\
\text{Resistivity}: & \quad \geq 10^{11} \ \Omega \cdot cm \\
\text{insulation strength}: & \quad \geq 5 \ \text{kV/mm}
\end{align*}
\]

\[
P = 1.1 \times 10^{-6} \ \text{C cm}^{-2} \text{K}^{-1}
\]
\[
D^* > 10^7 \ \text{cmHz}^{1/2} \text{W}^{-1}
\]
Low consumption power ferrites and devices

- The creation of ferroelectronic-ferromagnetic composite core
- Series of NiZn ferrites, broadband EMI core and devices, LTCC chip filter and EMI technology
- Lower the consumption of inductor/capacitor/transformer/switch power supply/EMI devices
- Devices consumption decrease 15%, cost decrease 14%, EMI ranging from 30dB to 70dB

- Developing Core materials from PC 30 to PC50;
- Owning 20 authorized patents (One Hongkong patent) and 20 in pending, 9 technology standards, and 26 publications;
- The technology was applied by more than 20 company and gain benefits more than 3200 million.
- National award in 2008
Semiconductor Ceramic Capacitors

- **Surface layer Capacitors:**
  \[ C: 0.01-0.2 \mu F; \text{Dielectric loss} < 3.5\%, \text{Resistance} > 1000M \Omega \]

- **Grain boundary layer capacitors:**
  \[ C: 0.01-0.1 \mu F; \text{Dielectric loss} < 1.0\%, \text{Resistance} > 1000M \Omega \]

25 publications in Mater. Lett., Electro. Mater. etc
Paper Publications

Enterprise Cooperation

Cooperation focus on: science research, training and laboratory development
The students will touch the front line of their major, deepen the comprehension to the fabricate procedures, and improve the understanding about international corporations.
Course cooperation with Intel, Agilent, and SMIC

Beginner:
- By engineers from SMIC
- Scales: Junior students (100%) /year

Advanced:
- By engineers from Agilent, SMIC
- Scales: 80-100 persons/year

Talent database: Certificate from companies
Thank you

Prof. Huaiwu, Zhang
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