

# 300 MM BEOL MANUFACTURING CAPABILITIES IN RUSSIA

# CROCUS NANO ELECTRONICS



**VLADIMIR KRUPNIK,**  
VP Business Development

**MAY 2019**



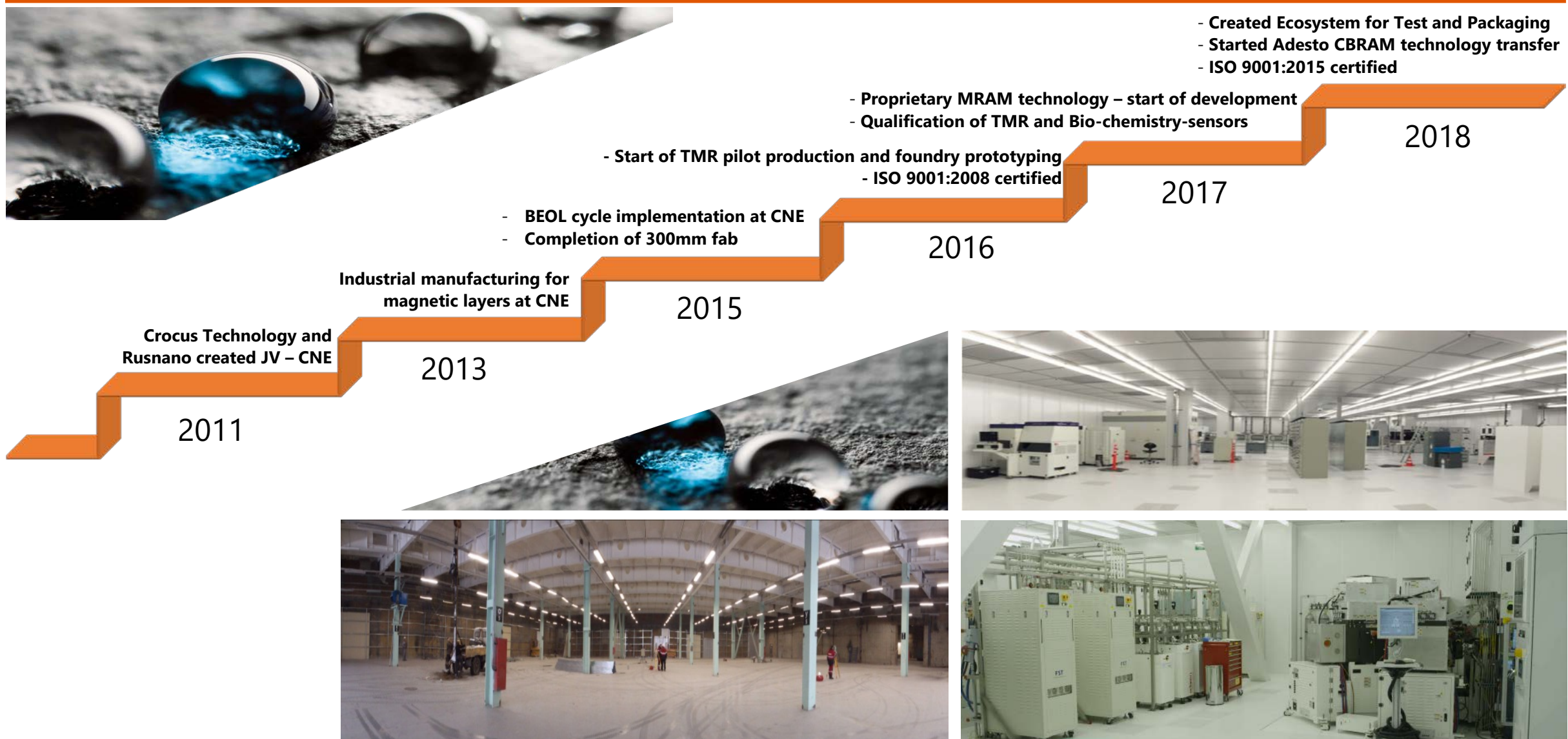
## ABOUT CNE

**CNE** is a pure-play **300 mm BEOL** Foundry with state of the art equipment, advanced process technologies and capabilities



**Crocus Nano Electronics (CNE)** was established in 2011 as a joint venture of Crocus Technology and Rusnano. Our fab is a specialty 300mm line, focused on BEOL processes such as emerging memories, wafer level magnetics, sensors, integrated passive components and advanced interposers.

# MILESTONES



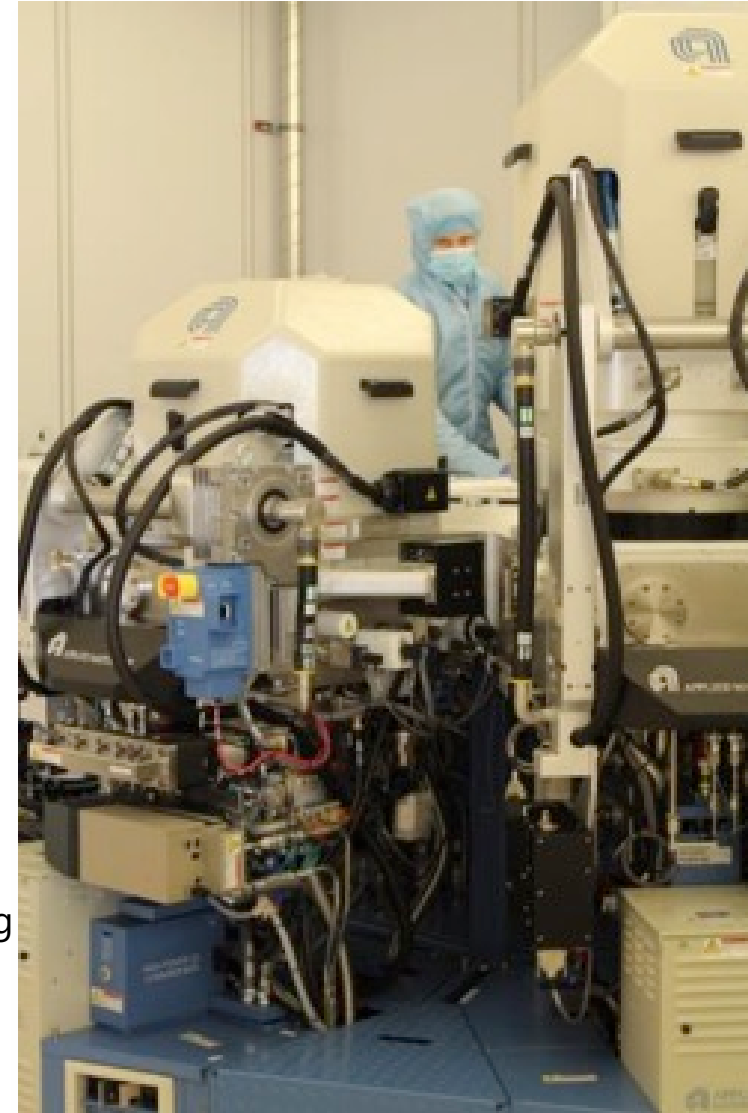


# KEY FACTS

- Base lithography feature size 65nm, further scaling in development
- Focus on Foundry services for Interposers, emerging BEOL memories (MRAM, RRAM, etc.), IPD, Bio- and Magnetic Sensors
- Actively developing customized process flow with customers for their applications
- State of the art 300 mm processing equipment and metrology
- Cleanroom:
  - 300mm wafer size
  - Cleanroom Area 2 500 m<sup>2</sup>
  - Classification ISO 4-7 (certified)
- Capacity up to 4000 wafer per month, expansion area available
- Export: 95%
- International team of highly qualified engineers
- Six Sigma Trained Engineering Staff with up to Black Belt certified
- Quality management systems ISO 9001-2015

## Wafer Processing Capabilities

- |  |                                 |
|--|---------------------------------|
| • Photolithography                     | • Chemical mechanical polishing |
| • Plasma dry etching                   | • Electroplating                |
| • Wet etching                          | • Annealing                     |
| • Dielectric plasma deposition (PECVD) | • Metrology                     |
| • Metallization (ME deposition) PVD    | • Wafer level test              |



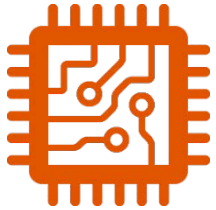
**CNE enables customers to commercialize products and ramp them to high volume quickly, reliably and cost effectively**

- **State of the Art Expertise:**
  - Lithography
  - Dry Etch
  - Magnetic Processing
  - Thin Films
  - Process Integration
  - Process Engineering & Development
  - Manufacturing & Industrial Engineering
- **State of the Art 300 mm processing equipment and metrology**
- **High Volume Manufacturing**
- **Customized development**
- **Six Sigma Trained Engineering Staff**

**CNE provides foundry services and turnkey solutions, including full product supply chain management**



# CNE IS ADDRESSING GROWING APPLICATIONS



**Embedded Memory** for low-power **MCU's**  
Technologies: STT MRAM and RRAM  
Applications: IoT, AI, industrial and Smart-sensors



**Magnetic Sensors:** TMR and GMR technology  
Applications: Consumer and industrial electronics, IoT, Smart-sensing



**Bio-Sensors**  
Technology: COT  
Applications: DNA sequencing, Point of Care, Pharmacology, R&D, Livestock farming



**High-Level Integration**  
Applications: Integrated passive devices, Silicon Interposers, Wafer level magnetics,



**IC's for RFID**  
Technologies: Based on RRAM and MRAM  
Applications: IoT, Control & Security, Tracing, Quality management and Manufacturing



**Customized Projects**  
Applications: R&D, prototyping, engineering services and etc.

Services offered by **CNE** include:

- Process Flow Development
- Prototyping
- Research and Development
- Non-Recurring Engineering
- 300mm BEOL Foundry services
- Volume BEOL manufacturing
- Test and Metrology
- Turn Key Solutions

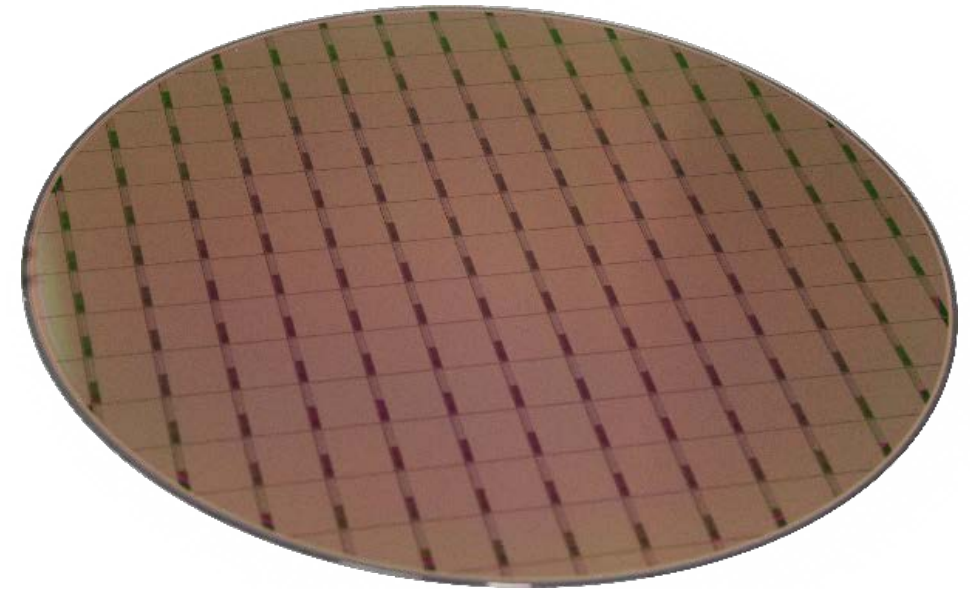
# PROPRIETARY STT MRAM TECHNOLOGY

**CNE develops an STT MRAM chip tailored for harsh environment and high reliability applications**

**CN04STT48R** is radiation tolerant 4 Mbit random access non-volatile memory based on STT MRAM p-MTJ technology

## Target specification:

- ✓ Advanced STT PMTJ MRAM technology
- ✓ High endurance ( $10^{11}$  cycles)
- ✓ Data retention 15 years (up to +125°C)
- ✓ Low voltage data protection circuitry (below 1.8V)
- ✓ Read rate 6 Mbps
- ✓ Write rate 1Mbps
- ✓ High reliability
- ✓ Dual power supply 1.8V; 3.3V
- ✓ Radiation environment sustainability
- ✓ Operating Temperature Range is -55°C to +125°C
- ✓ Package: 48 Lead Shielded Ceramic Quad Flat Pack



**STT MRAM** test chip



# EMERGING NON-VOLATILE MEMORY

## Available Embedded Memory Technologies:

- ✓ **MRAM**
- ✓ **RRAM**

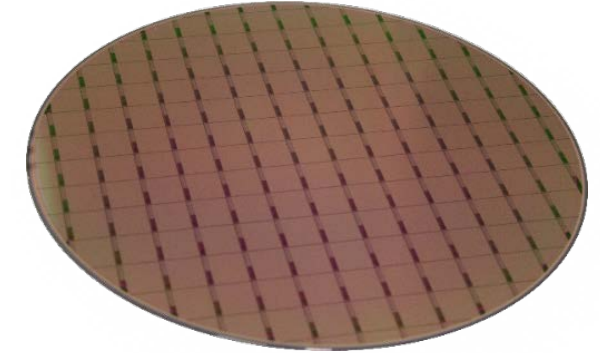
## Our Services:

- Process development
- Back-end-foundry for embedded solutions on 300mm wafers
- Turn-key solutions (include design, mask processing and packaging)

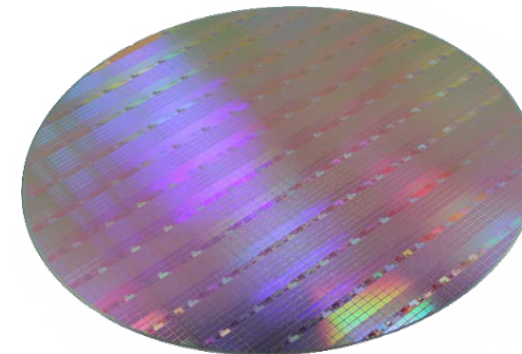
## Applications:

- Embedded memory for MCU\MPU and other
- Low power IoT solutions (including RFID)
- Smart-cards and secure IC's (COT)
- Customized ASIC\ASSP devices (COT)

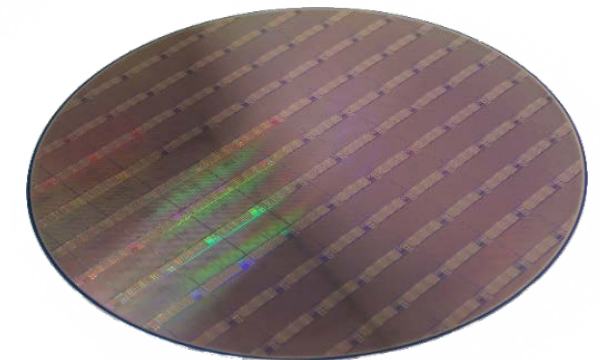
	STT-MRAM	DRAM	eSRAM	NAND-Flash	eFlash
access time	20 -3 ns	10-20 ns	2-10 ns	10-100 us	10-100 us
bit footprint	50-6 F2	6F2	100+ F2	1 F2	100F2
node	70-20 nm	22 nm	22 nm	14 nm	45-65 nm
non-volatility	yes	No	No	yes	Yes
market		\$30-40B	\$10B	\$40B	\$1B



**CNE STT MRAM** test chip



**Memory test-chip**



**NFC IC's with MRAM**





# MICRO-FLUIDIC SYSTEM FOR DNA SEQUENCING

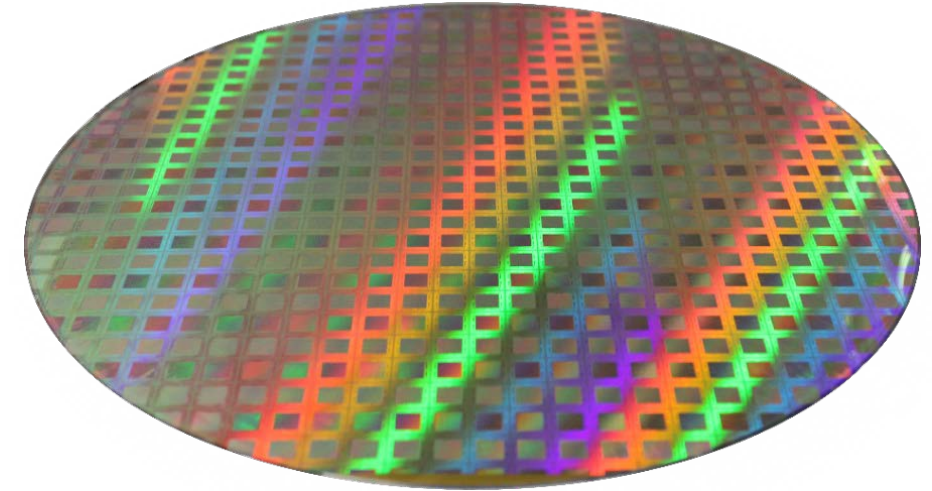
**April 2016:** start of project for developing and manufacturing Micro-fluidic biosensors for rapid diagnosis of diseases and infections

**300mm** Back End of Line – perfect process for mass production of microfluidics:

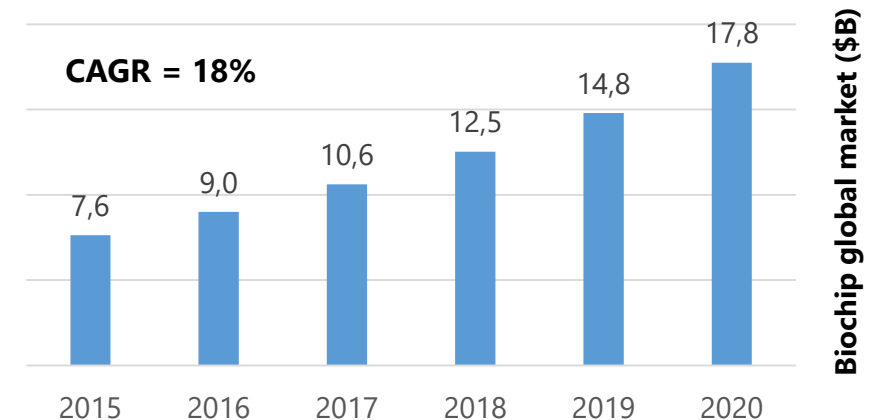
- ✓ Flexible manufacturing
- ✓ IP protection
- ✓ Highest number of dies on wafers

Unique Project for all industry

- ✓ First biochip product on 300mm wafers
- ✓ High repeatability and cost-effective for HVM production
- ✓ Next step for mass-available technologies of precise medicine



**Biochip prototypes on 300mm wafers**



Source: Markets-and-Markets

# TMR – MAGNETIC SENSORS

**TMR** (tunnel magneto-resistance) sensors – next generation of high sensitivity magnetic sensors based on MTJ's (magnetic-tunnel junction) quantum elements.

Relative to a Hall effect, GMR and AMR sensors, **TMR** has

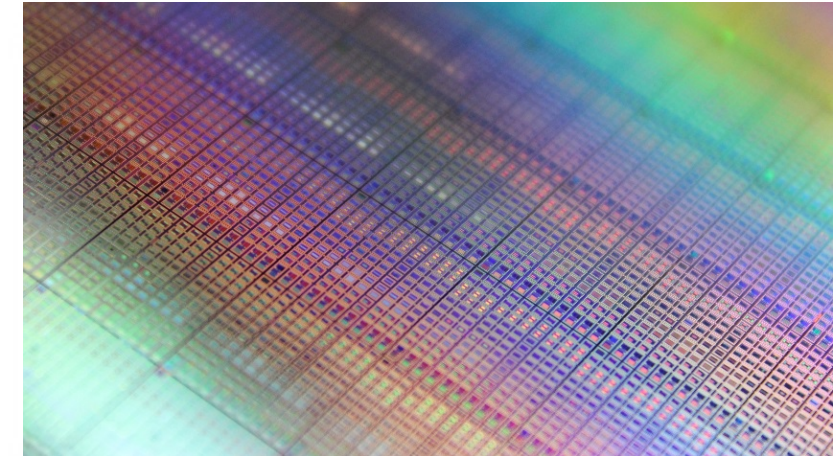
- ✓ better temperature stability,
- ✓ higher sensitivity,
- ✓ lower power consumption,
- ✓ better linearity.

Our Services:

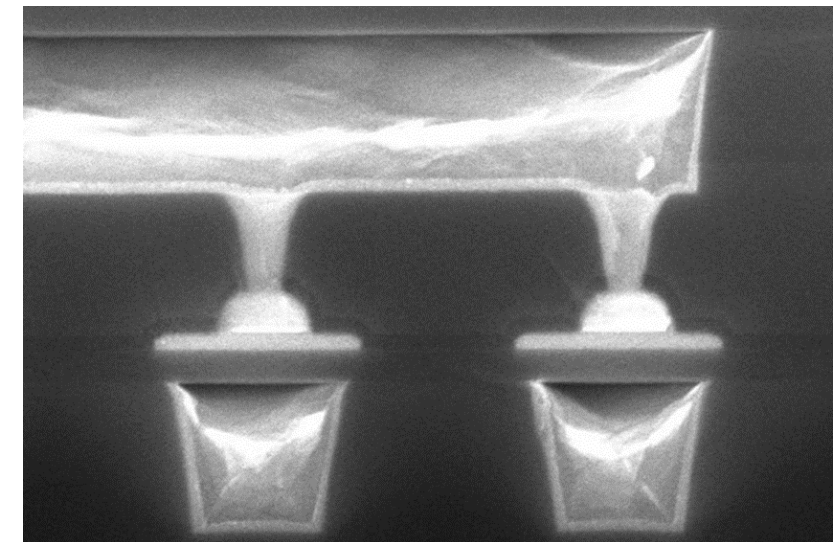
- ✓ Magnetic simulations
- ✓ Process development for customized devices manufacturing
- ✓ Foundry services
- ✓ Turn-key solution (include CMOS integration, package, test and certification)

Our experience and competitive advantages help to create customized sensor for special applications:

- |              |                         |
|--------------|-------------------------|
| ✓ Automotive | ✓ Industrial Automation |
| ✓ Smart-home | ✓ Measurements          |
| ✓ Energy     | ✓ Consumer electronics  |
| ✓ IoT        | ✓ White Goods           |
| ✓ Robotics   |                         |



**TMR sensors: ~150K dies on 300mm wafers**



**Cross-sections of MTJ's**

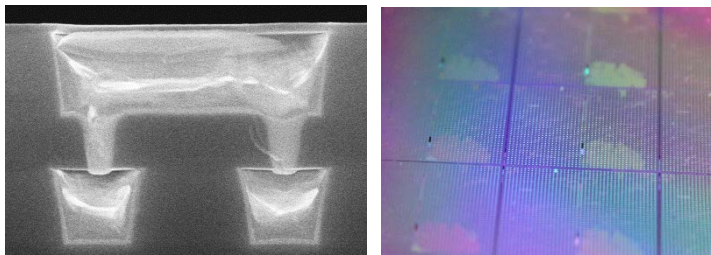
# HIGH-LEVEL INTEGRATION

**IPD's** (Integrated Passive Devices): baluns, filters, couplers, and diplexers – next step of Integration and Miniaturization – major challenges for semiconductor industry driven by IoT.

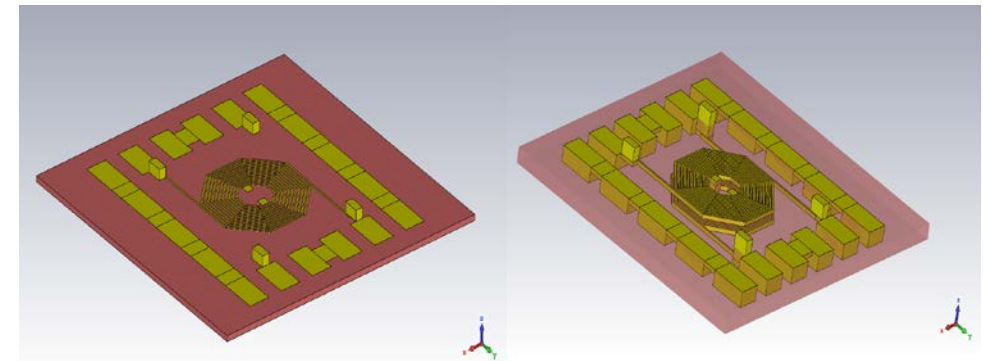
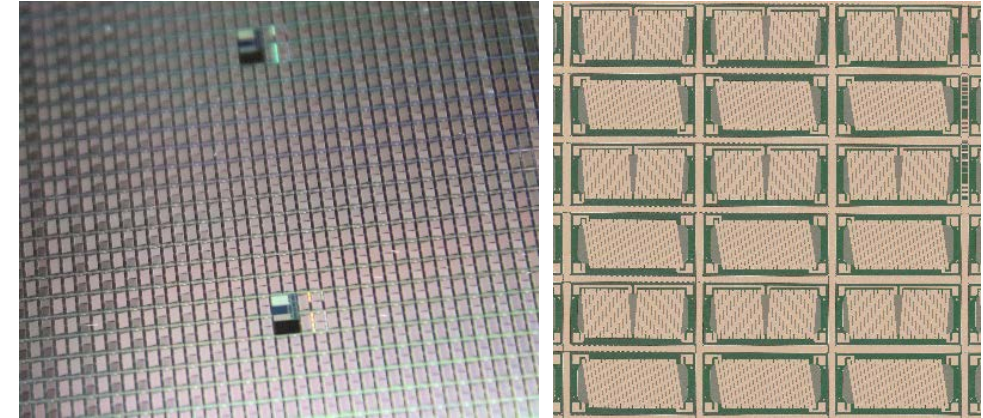
CNE offer copper on high resistivity silicon platform ideal for the IPD's that are used in portable, wireless and RF applications

Our advantages:

- ✓ Simulations;
- ✓ 300mm wafers – high number of dies per wafer;
- ✓ Flexibility – customized manufacturing for prototyping and low-volume production;
- ✓ Turn key solution: design, photomasks, packaging and test;
- ✓ Wafer level magnetics.



Ultra-thin interposers for system-in-package.  
Main applications: UHF and 5G



Integrated passive devices: prototype of nano-inductors



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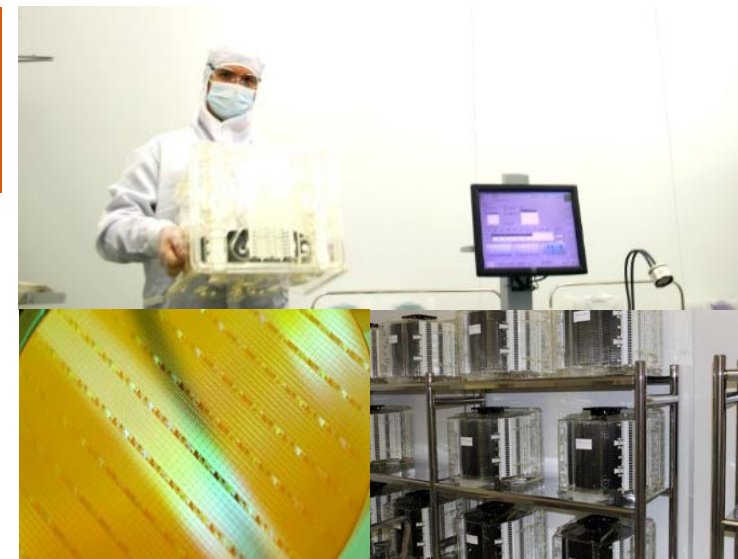




# 300MM BEOL FOUNDRY SERVICES

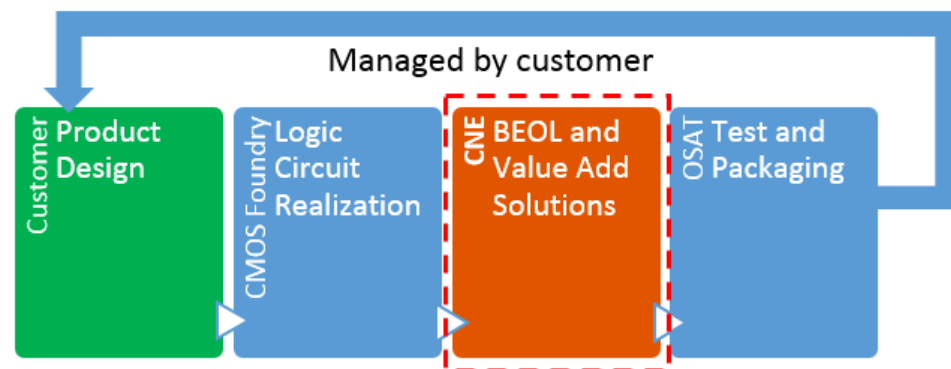
**CNE provide turnkey and customized cost-effective services and solutions, surpassing our customer's expectations at every step.**

- Trusted foundry partner for Integrated Passive Devices, Interposers, Magnetic Devices & Biosensors
- **CNE's** BEOL technology is CMOS compatible
- Flexible and high-expertise manufacturing services

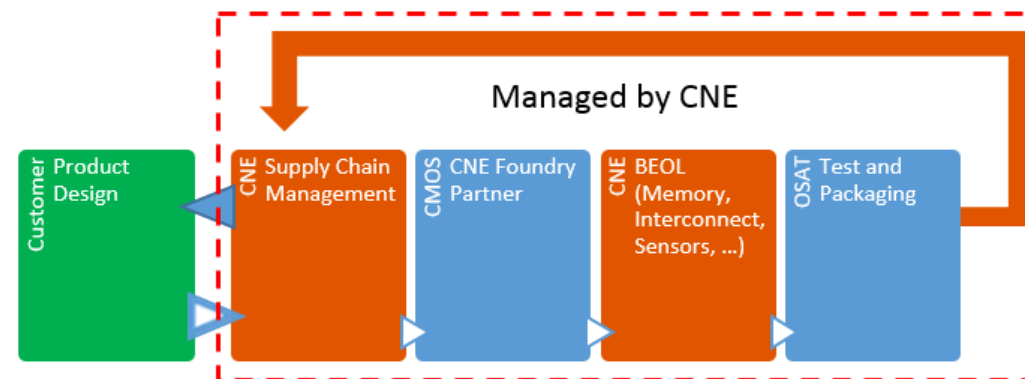


We offer TWO main models

## Pure play foundry



## Turnkey



# CNE PARTNERS

## FEOL CMOS Foundry partners



上海华力微电子有限公司  
Shanghai Huali Microelectronics Corporation



## Technology and design partners



## Photomasks partners



## Test and Package partners



# Russia as a growing opportunity

- **CNE view of the Russian microelectronics market**
  - Semiconductor manufacturing
  - Packaging
  - Device Design
  - Product companies
- **Strengths**
  - Engineering capabilities (education)
  - Low labor cost
  - Flexibilities
  - Low volumes (R&D and customized solutions)
- **Weaknesses**
  - Engineering capabilities (hands on experience)
  - Political situation
  - Immature market
  - Lack of fabless product companies
  - Lack of local communication and legitimate experience

# Create Russian market

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- Not only to sell
- Be a true partner, Invest into Russia
- Introducing our Friends and Partners

**Let's all make it happen!!!**



# CNE LOCATION

**CNE** located in Technopolis "Moscow"

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E-mail: [info@crocusnano.com](mailto:info@crocusnano.com)

Web: <http://crocusnano.com/>



# TECHNOLOGY TOUR TO THE CNE FAB

Also as part of **SEMIExpo Russia 2019**, we invite you to take part in a **Technology tour to the Crocus Nano Electronic Fab**. You can see state of the art microelectronic 300mm production – the tour will be held on 15th of May 2019, 13:00-16:00

## SCHEDULE:

**12:50**

We will wait you tomorrow in 12:50 near **Booth C16, Meeting point**

**13:00**

The direct bus from SEMIEXPO Russia 2019 to CNE Fab departs

**16:00**

The direct bus from CNE Fab to Taganskaya metro station departs



# CROCUS NANO ELECTRONICS

We are here to help with  
your business ideas

**THANK YOU FOR YOUR  
ATTENTION**

CONTACT US / [WWW.CROCUSNANO.COM](http://WWW.CROCUSNANO.COM)

