

# MICRO/ULTRAMICRO ELECTRODE LENR DETECTION

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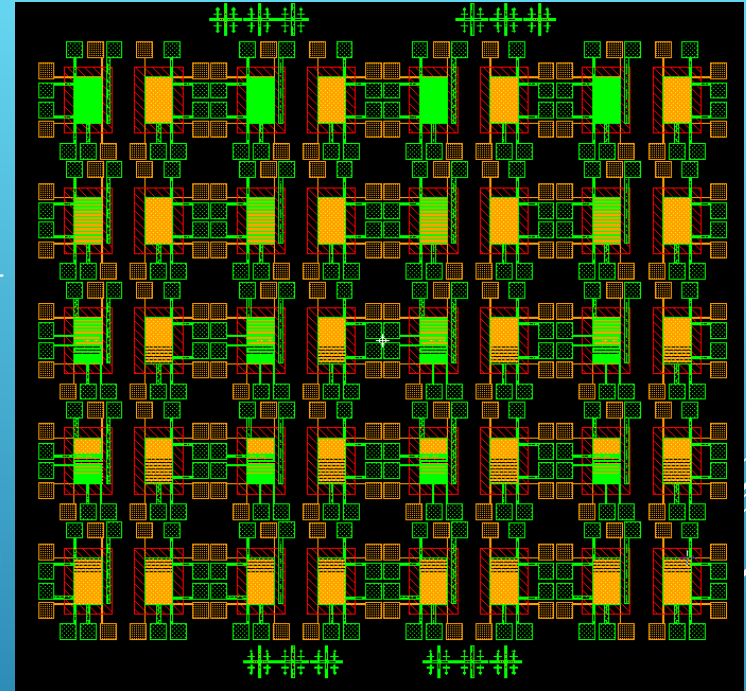
ReResearch LLC

November 20th, 2013

- ▶ High materials throughput
  - ▶ Parallelization
- ▶ Study diffusion limited and non-diffusion limited regimes
  - ▶ Tailor experiment to achieve high flux and high loading
  - ▶ Electrode faceting
- ▶ On-Chip:
  - ▶ Anode & Cathode real-time resistance measurements
  - ▶ Low dT measurements
  - ▶ Induce electrode changes during experiment
  - ▶ Probe effects of capacitance & magnetic field
- ▶ External:
  - ▶ Soft x-ray detection >6 keV
  - ▶ UV-vis

## SUMMARY OF UNIQUE CAPABILITIES

- ▶ 20 devices per batch
- ▶ ME/UME small size & registry on devices
  - ▶ Surface area or features vs bulk properties
  - ▶ specific electrode areas to be monitored throughout lifetime of device
    - ▶ SEM, TEM, +other spectroscopy
- ▶ Tradition FPE or codeposition
  - ▶ Eliminate rolling processing:
    - ▶ Impurity effects in vacancy formation & morphological changes
  - ▶ Utilize
    - ▶ E-beam, sputtering, electrodeposition, co-deposition, possibly electroless co-deposition
  - ▶ On-demand generation of faceted structures
  - ▶ Porous structures

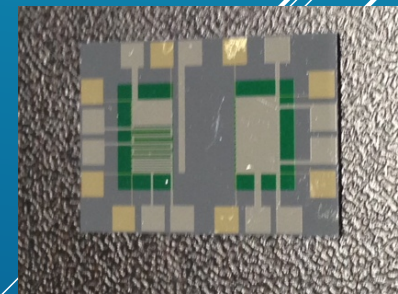
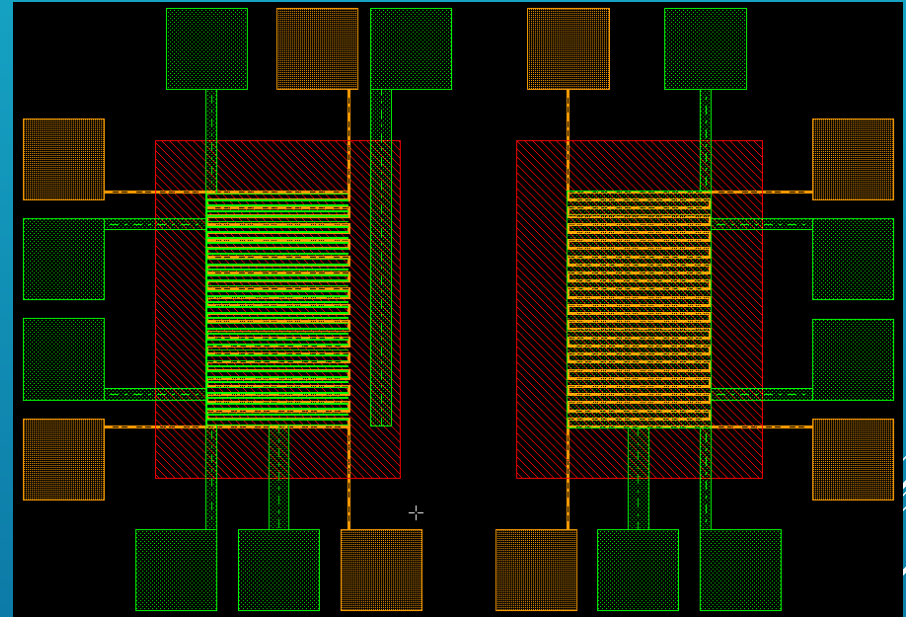


## MATERIAL THROUGHPUT & ANALYSIS

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## SUMMARY OF UNIQUE CAPABILITIES

- ▶ Temperature Measurements
  - ▶ 4 point probe (4pp) anode & cathode
  - ▶ can resolve  $dT$  of  $1\text{mK} \sim 1\text{mW}$  excess heat (COMSOL)
  - ▶  $dT_a - dT_c$
- ▶ Resistance & external stimulation
  - ▶ 4pp anode & cathode - resistance
  - ▶ External impulse
    - ▶ Electromagnet
    - ▶ AC or DC biasing – capacitance effects
    - ▶ Thermal shock



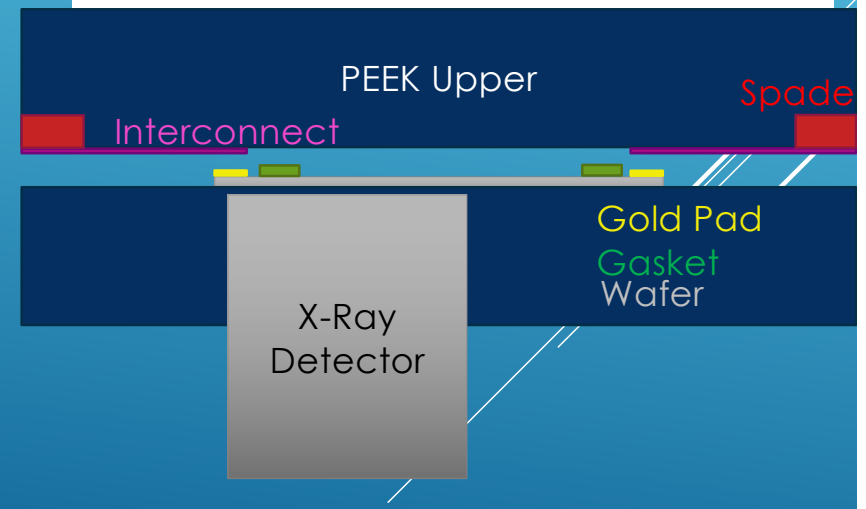
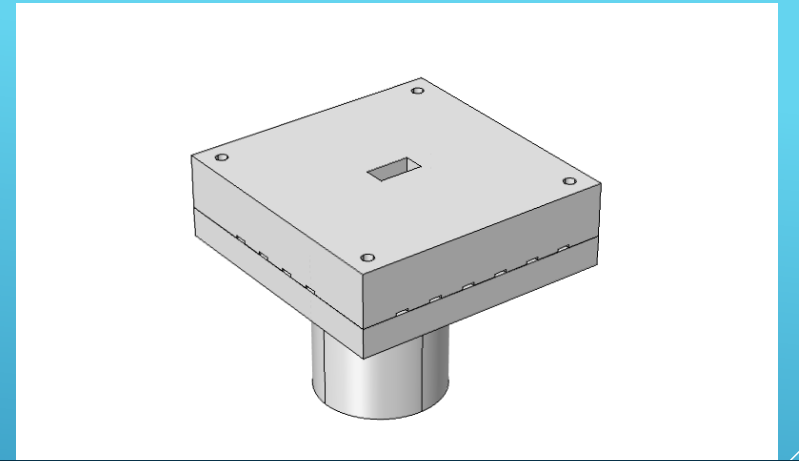
# SIMULTANEOUS ON-CHIP MEASUREMENTS

\*IN ADDITION TO TRADITIONAL ELECTROCHEMISTRY: VOLTAMMETRY, COULOMETRY, EIS

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## SUMMARY OF UNIQUE CAPABILITIES

- ▶ X-ray:
  - ▶ Current: low limit ~100 keV
  - ▶ ReResearch LLC
    - ▶ > ~6 keV
    - ▶ Single photon detection
- ▶ Potential integration
  - ▶ UV-vis



# EXTERNAL MEASUREMENTS

- ▶ High materials screening throughput
  - ▶ Low mass → shorter loading time
  - ▶ Surface area is roughly the same size as current electrodes
- ▶ Spectroscopic spatial characterization on small area electrode
- ▶ High flux conditioning
- ▶ Simultaneous sensitive multi-point detection
  - ▶ More complete picture of system

## SUMMARY