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Biosensors for Olfactory Cell Monitoring

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Outline

- Introduction
- Bioamplifier
- Biocompatible Methods and Materials
- Bench Testing
- Experiment Results
- Conclusion
- Acknowledgments

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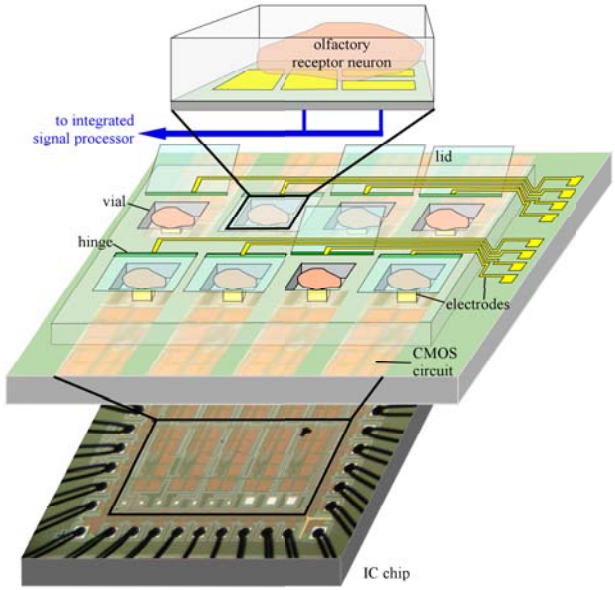
Introduction

- Combining electronics and living cells has a wide array of applications.
  - Pathogen detection
  - Drug screening
  - Medical diagnosis
  - Scientific research



- Developing an interface between integrated electronics and olfactory sensory neurons.
- Collaborating with neuroscientist at Johns Hopkins University.
- Monitor response after exposure to various stimuli.
- Detect weak extracellular signals with a CMOS bioamplifier

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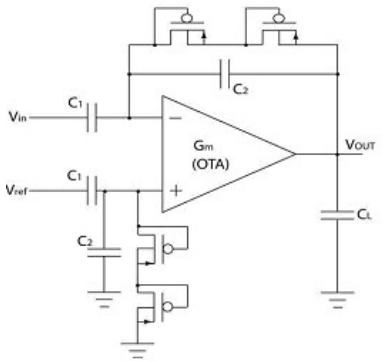
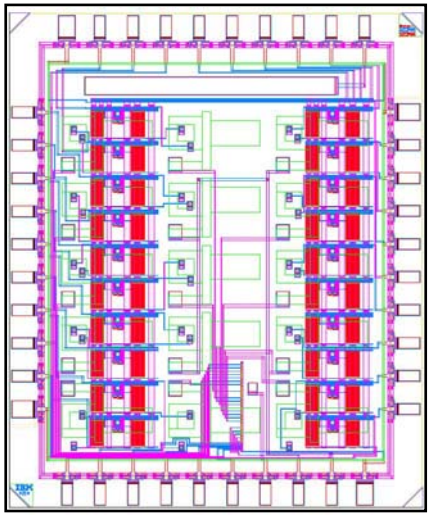
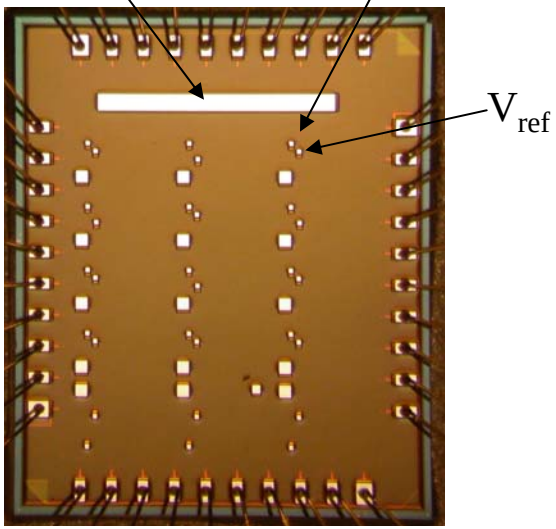
Bioamplifier

- Amplifier designed for low-power and low-noise.
- Input taken differentially between cell sensing and reference electrodes.
- Fifteen amplifiers arrayed on chip.
- Power supply ±1.25V; Gain 100V/V; Bandwidth 3kHz; Input referred noise ~50μV.







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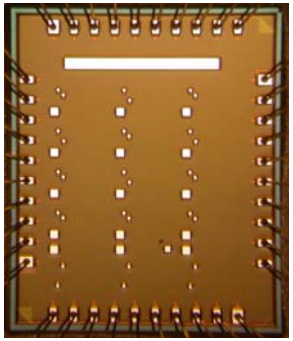
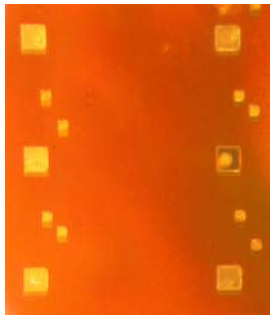
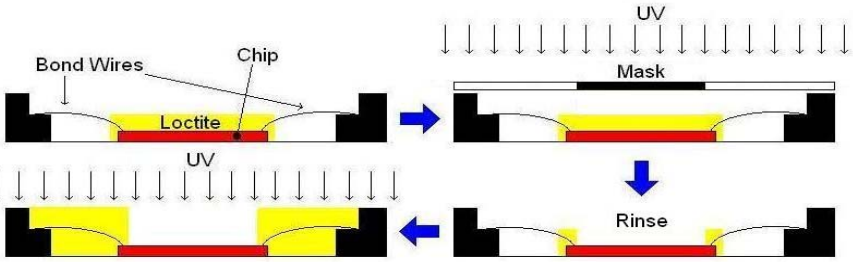
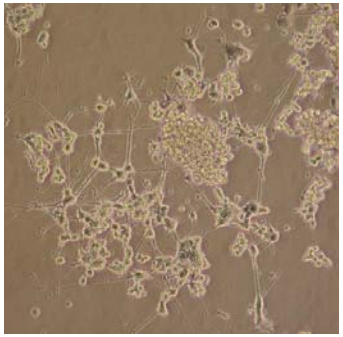
Biocompatible Methods and Materials

- Cells require aqueous media. We implement biocompatible post packaging.
  - Electroless plating
  - Chip encapsulation
- Experiments conducted with PC12 cells. These live longer *in vitro* than olfactory neurons.

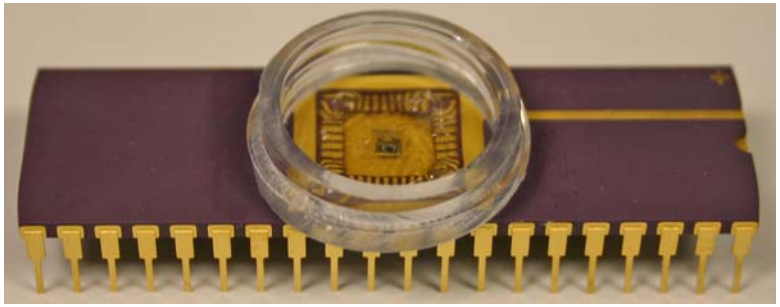








Differentiated PC12 cells



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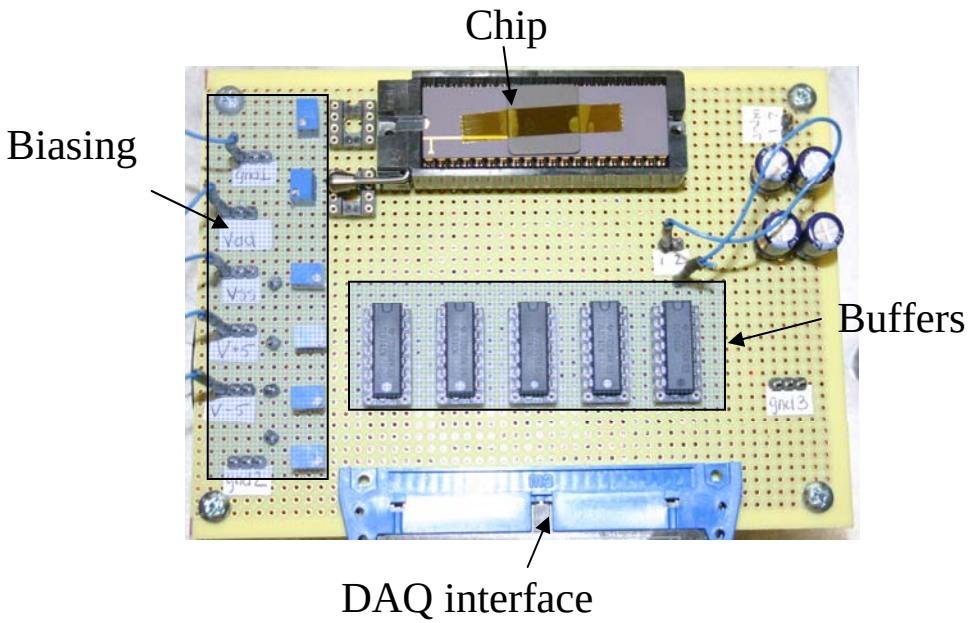
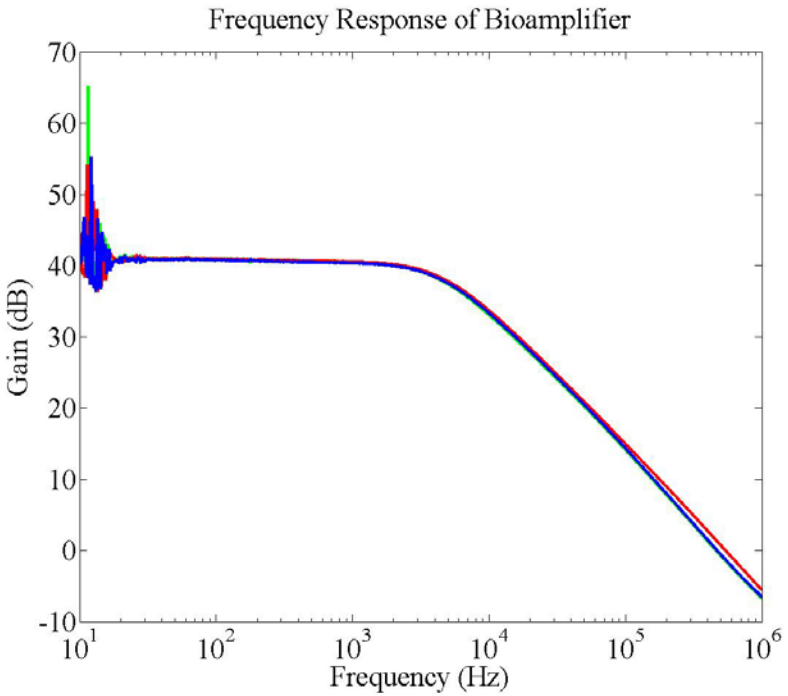
Bench Testing

- Bench testing of new chip.
  - Frequency response
  - Noise measurement
- New packaging material obtained.
  - Nuva-Sil®
- New test board fabricated .





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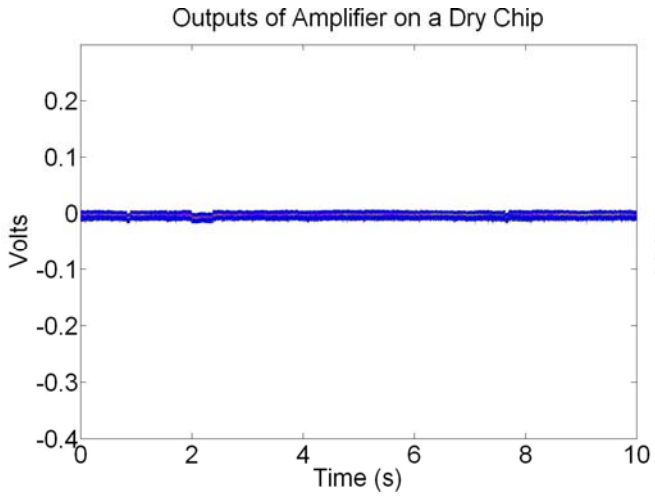
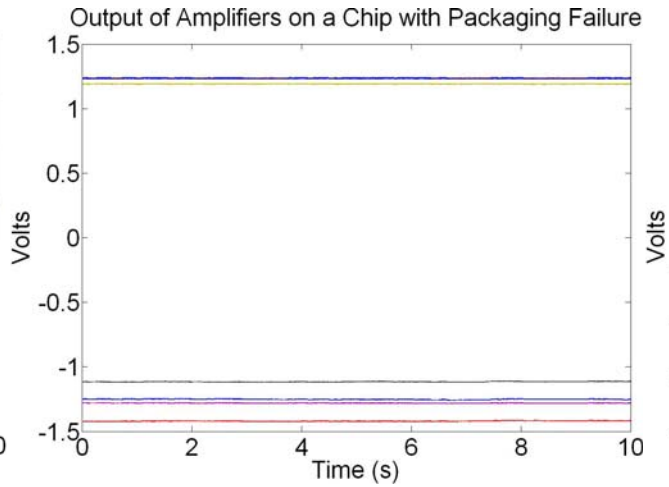
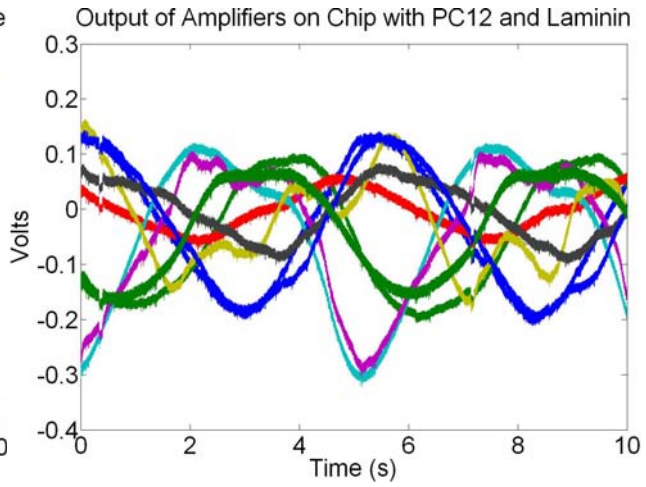
Experimental Results

- Experiment conducted with cells after four days of treatment with NGF
- Cells successfully cultured on chip
- Packaging successful. Amplifiers operational after 6 days.
- Further investigation will bring better understanding of signals observed







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Conclusions

- Bioamplifier chip successfully bench tested
- Measurement results match design characteristics.
- PC12 cells successfully cultured on chip. Cell viability confirmed.
- Packaging success. Amplifiers operational after 6 days.
- Further research to better understand signals obtained during experimentation.

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