# Novel Aerosol Jet Printed Organic Operational Amplifier

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## Introduction

Printed electronics provide a low cost, mass producible alternative to traditional electronics manufacturing techniques, which involve very expensive clean rooms [1,2]. The ability to integrate different materials into printed electronics allows them to be easily made into biosensors [3].

Printed electronics are also biodegradable, and can be washed away with water or other solvents, this makes them an attractive alternative to silicon based electronics in order to combat the rise in waste electronic equipment [3].

## Aims & Objectives

- Fabricate and characterise a variety of organic electronics including transistors, amplifiers, and diodes.
- Design the internal operational amplifier (Op-Amp) circuitry using FETs [4].

## Methodology

- Using the OPTOMEC Aerosol Jet Printer
- Using different organic materials to create electronics

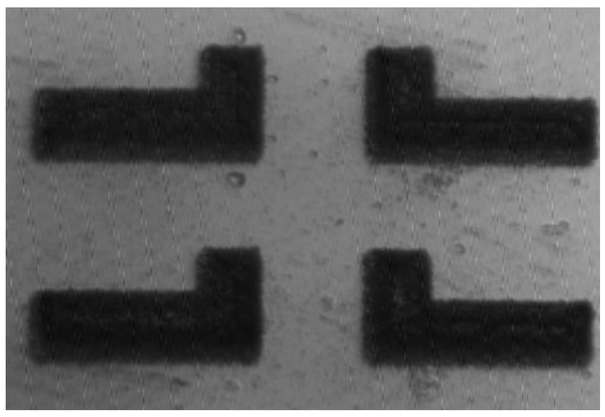

**Figure 1** - Conductive Contacts

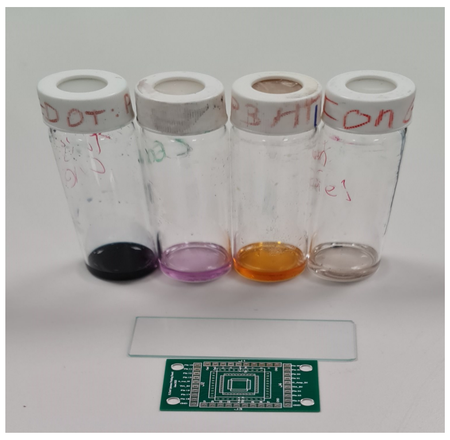

**Figure 2** - Organic Materials.

## Devices

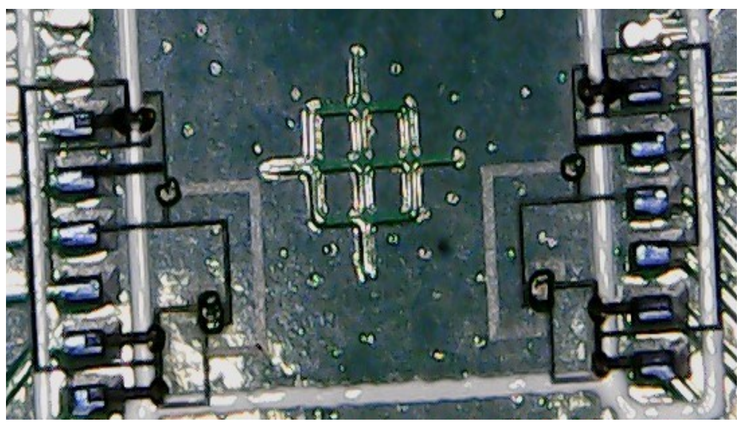

**Figure 3** - Printed Operational Amplifiers

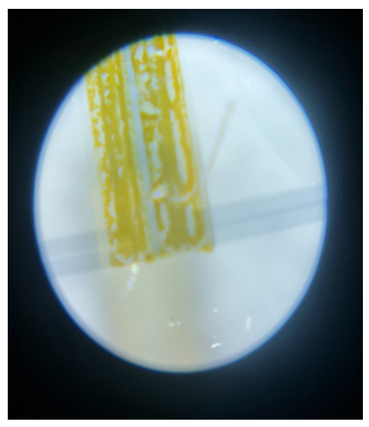

**Figure 4** - Printed Transistor

## Results

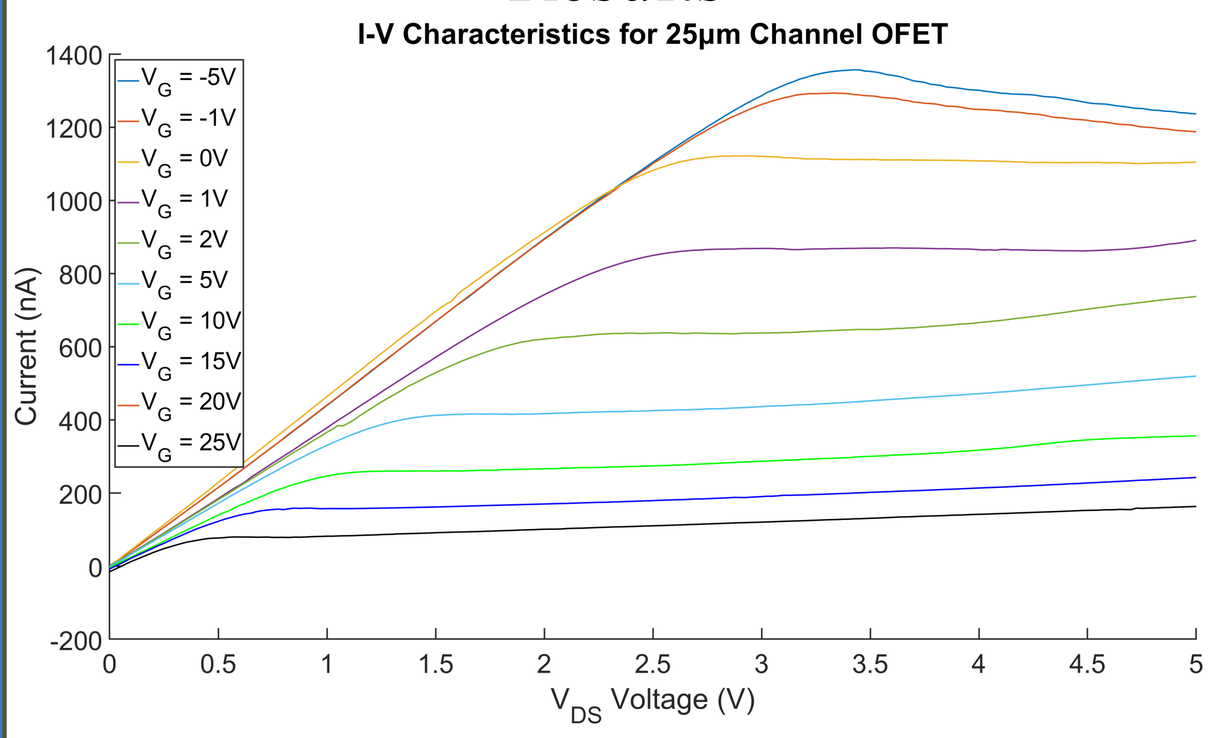


**Figure 5** - Printed Transistor Characteristics

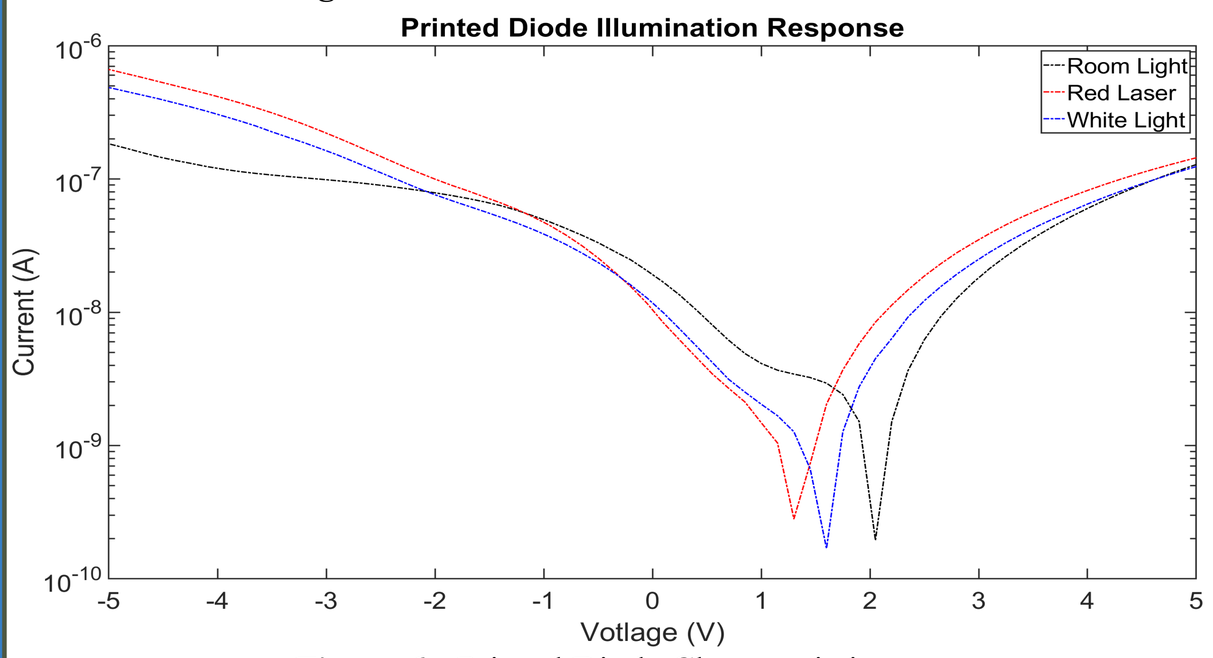


**Figure 6** - Printed Diode Characteristics

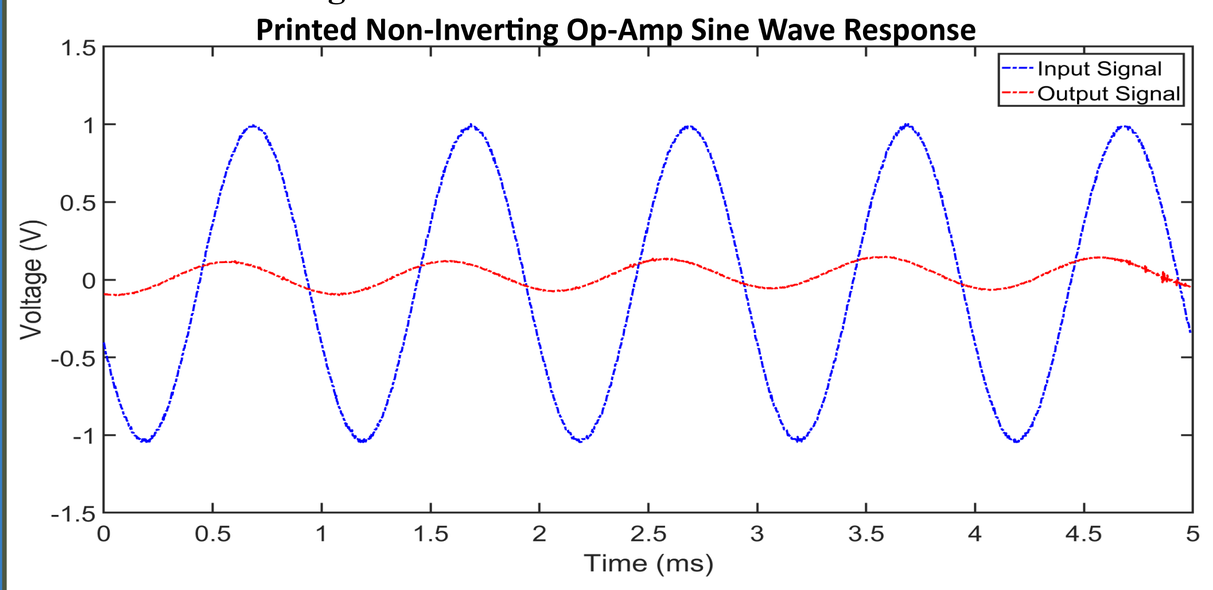


**Figure 7** - Printed Op-Amp Transfer Characteristics

## Future Developments

Advances in organic electronics will pave the way for the development of printed biosensors, revolutionizing remote health monitoring infrastructure and rendering COVID-19-style tests obsolete. Additionally, the biodegradable nature of organic electronics will significantly reduce the environmental impact associated with such tests.

References

[1] Z. Cui and C. Zhou, *Printed electronics : materials, technologies and applications*. Singapore: Wiley : Higher Education Press, 2016.

[2] A. A. Gupta, A. Bolduc, S. G. Cloutier and R. Izquierdo, "Aerosol Jet Printing for printed electronics rapid prototyping," *2016 IEEE International Symposium on Circuits and Systems (ISCAS)*, Montreal, QC, Canada, 2016, pp. 866-869, doi: 10.1109/ISCAS.2016.7527378.

[3] J. Wiklund *et al.*, "A Review on Printed Electronics: Fabrication Methods, Inks, Substrates, Applications and Environmental Impacts," *Journal of Manufacturing and Materials Processing*, vol. 5, no. 3, p. 89, Aug. 2021, doi: 10.3390/jmmp5030089.

[4] Matsui, H., Hayasaka, K., Takeda, Y. *et al.* Printed 5-V organic operational amplifiers for various signal processing. *Sci Rep* **8**, 8980 (2018). https://doi.org/10.1038/s41598-018-27205-7

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