

Printable Nanoelectronics: Low-Cost Prototyping with a Pen Plotter

Gülsüm Ersü

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Abstract

The recent advancements in solution-processable organic semiconductors have opened new opportunities for the use of ink-printing lithographic techniques in the fabrication of electronic devices quickly and easily. Despite the broadened range of materials that can be utilized for ink-printing lithography, the high cost of equipment required for the most widespread methods poses a challenge for many laboratories to start producing ink-printed devices. Motivated by these attempts, we propose a cost-effective and robust method of printing nanomaterial-based inks on paper substrates using benchtop plotters and refillable pens. This highly versatile approach can print various solution-processable nanomaterials with pattern features as narrow as 80 μm . We demonstrate the potential of this technique by printing van der Waals materials, organic semiconductors, hybrid perovskites, and colloidal nanoparticles with a broad range of properties, from insulators to superconductors. This technique can inspire new avenues of research in printed electronics, and provide an opportunity for more labs to adopt and benefit from this technology.

References

- [1] Forrest, S. R., *Nature* 428 (2004), 911–918.
- [2] Andersson, P. et al. *Adv. Mater.* 14 (2002), 1460–1464.
- [3] Gao, M., Li, L. & Song, Y. J. *Mater. Chem. C* 5 (2017), 2971–2993.
- [4] McManus, D. et al. *Flex. Print. Electron.* 3 (2018), 34005.
- [5] Hernandez, Y., Nicolosi, V., Lotya, M. et al. *Nature Nanotech* 3 (2008), 563–568.

Figures

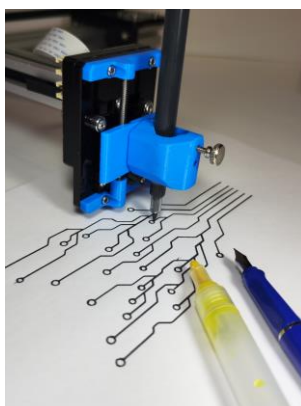


Figure 1: Digital photograph of the plotter system used for plotting a circuit