

# Metal phthalocyanine organic thin-film transistors: changes in electrical performance and stability in response to temperature and environment

*Nicholas T. Boileau, Rosemary Cranston, Brendan Mirka, Owen A. Melville, and Benoît H. Lessard\**

University of Ottawa, Department of Chemical and Biological Engineering

161 Louis Pasteur, Ottawa, Ontario, K1N 6N5

\*Corresponding Author. E-mail: benoit.lessard@uottawa.ca

## Supplementary Information

Figures S1-S13 display baseline transfer and output curves and temperature response curves for CoPc, TiOPc, ZnPc, Fe(II)Pc, MgPc, and CuPc.

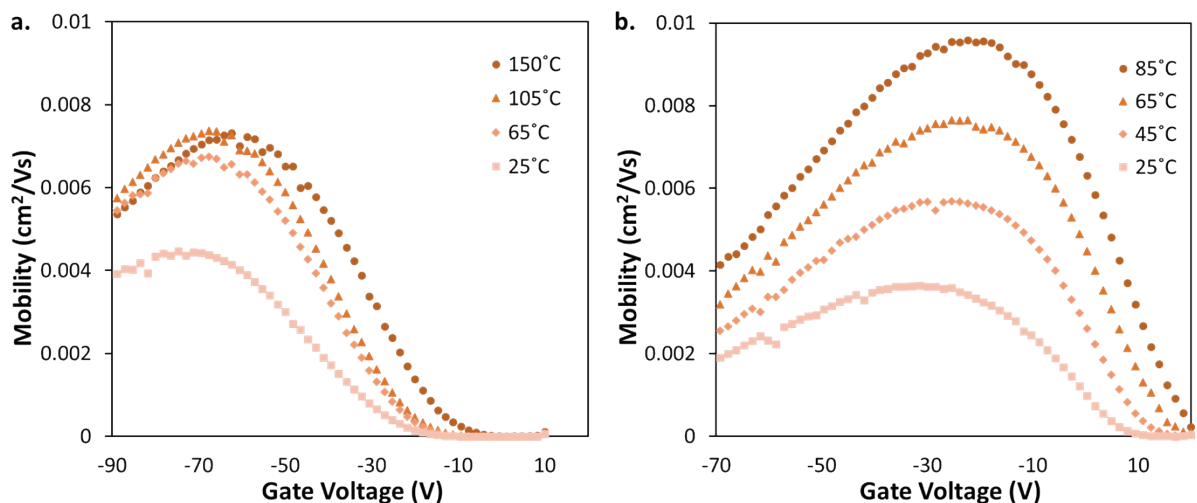


Figure S1. Field-effect mobility for CoPc BGBC devices, deposited at  $T = 140^\circ\text{C}$  and tested in a) vacuum, b) air, with respect to applied gate-source voltage ( $V_{GS}$ ) for characteristic devices at varied temperatures. This mobility was calculated between adjacent points in the transfer data using equation 2. Devices were tested in the range of  $T = 25^\circ\text{C}$  to  $T = 85^\circ\text{C}$  in air, and  $T = 25^\circ\text{C}$  to  $T = 150^\circ\text{C}$  in vacuum.

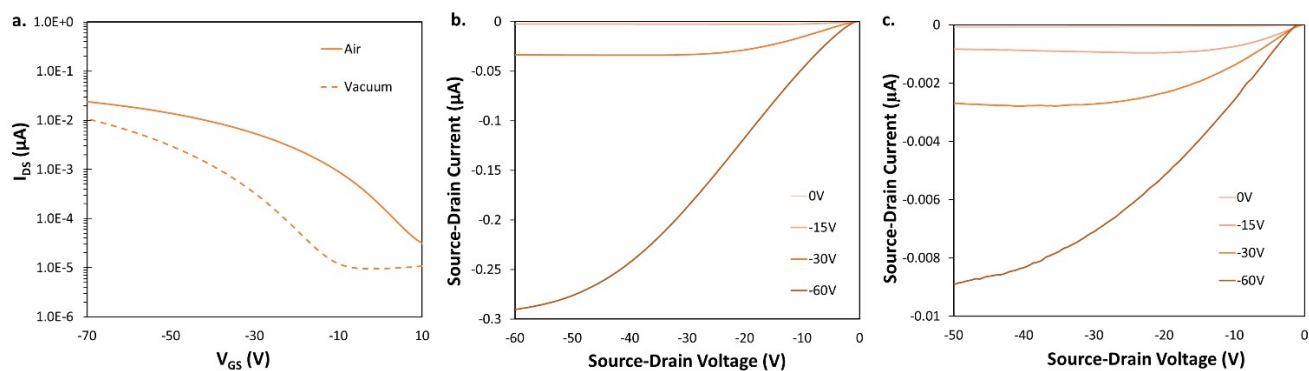


Figure S2. Characterization of CoPc OTFTs. (a) transfer curves for CoPc BGBC devices deposited at  $T = 140^\circ\text{C}$ , and tested in air, and vacuum, at  $T = 25^\circ\text{C}$ . Output curves for identical devices in air (b) and vacuum (c).

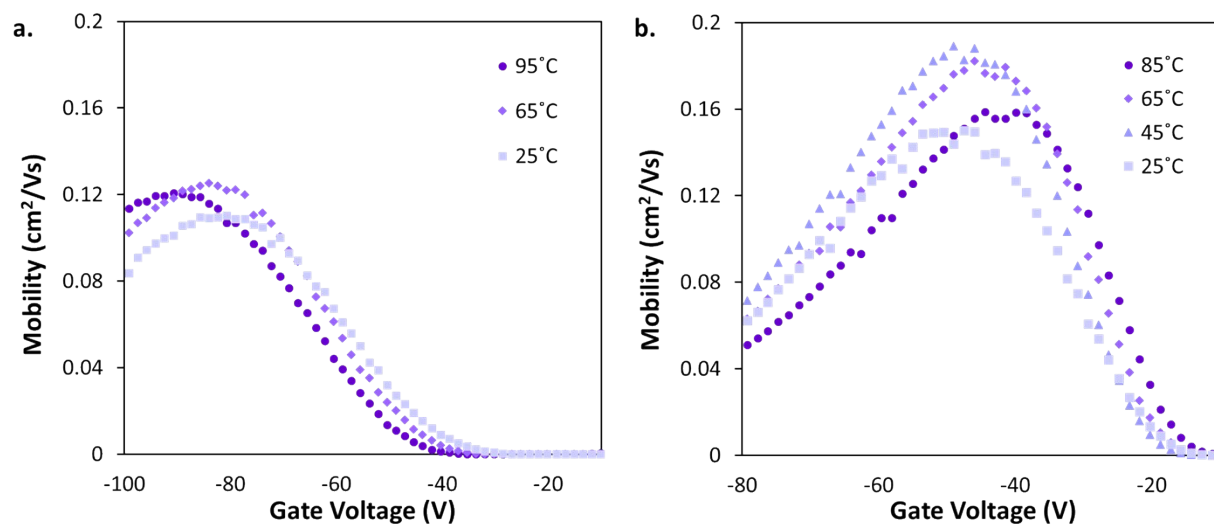


Figure S3. Field-effect mobility for TiOPc BGBC devices, deposited at  $T = 140^\circ\text{C}$  and tested in a) vacuum, b) air, with respect to applied gate-source voltage ( $V_{GS}$ ) for characteristic devices at varied temperatures. This mobility was calculated between adjacent points in the transfer data using equation 2. Devices were tested in the range of  $T = 25^\circ\text{C}$  to  $T = 85^\circ\text{C}$  in air, and  $T = 25^\circ\text{C}$  to  $T = 150^\circ\text{C}$  in vacuum.

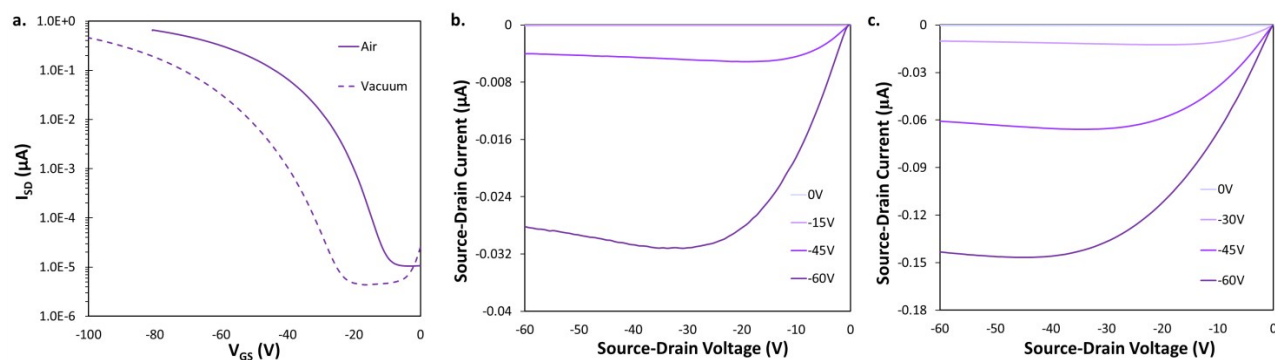


Figure S4. Characterization of TiOPc OTFTs. (a) transfer curves for TiOPc BGBC devices deposited at  $T = 140^\circ\text{C}$ , and tested in air, and vacuum, at  $T = 25^\circ\text{C}$ . Output curves for identical devices in vacuum (b) and air (c).

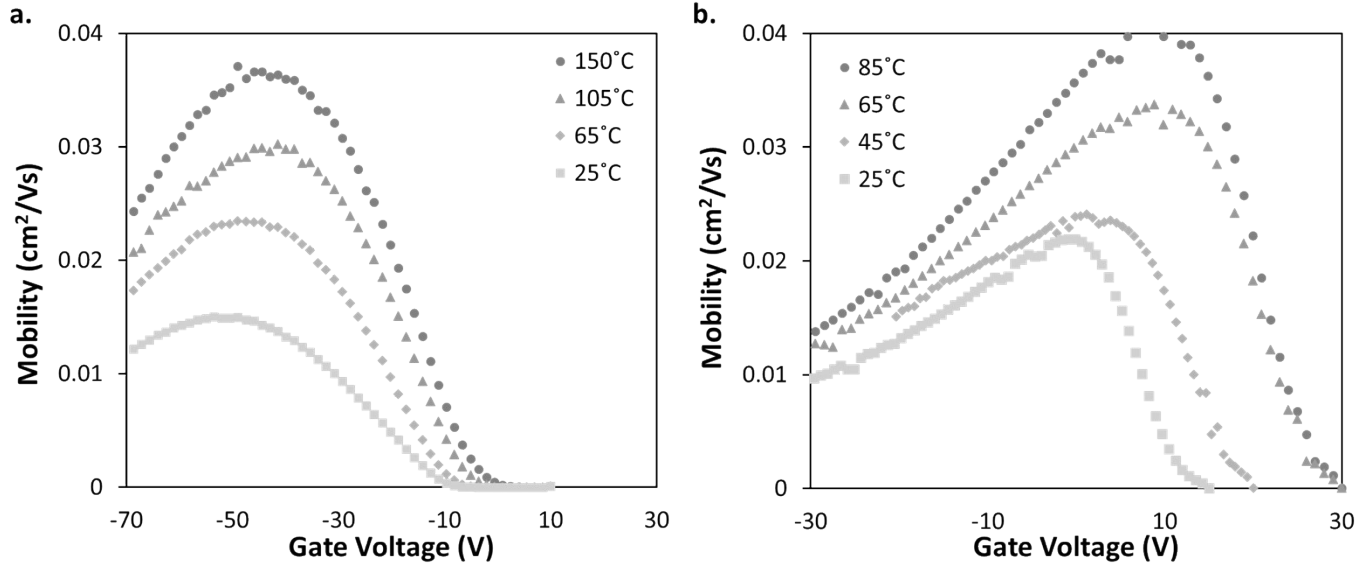


Figure S5. Field-effect mobility for ZnPc BGBC devices, deposited at  $T = 140^\circ\text{C}$  and tested in a) vacuum, b) air, with respect to applied gate-source voltage ( $V_{GS}$ ) for characteristic devices at varied temperatures. This mobility was calculated between adjacent points in the transfer data using equation 2. Devices were tested in the range of  $T = 25^\circ\text{C}$  to  $T = 85^\circ\text{C}$  in air, and  $T = 25^\circ\text{C}$  to  $T = 150^\circ\text{C}$  in vacuum.

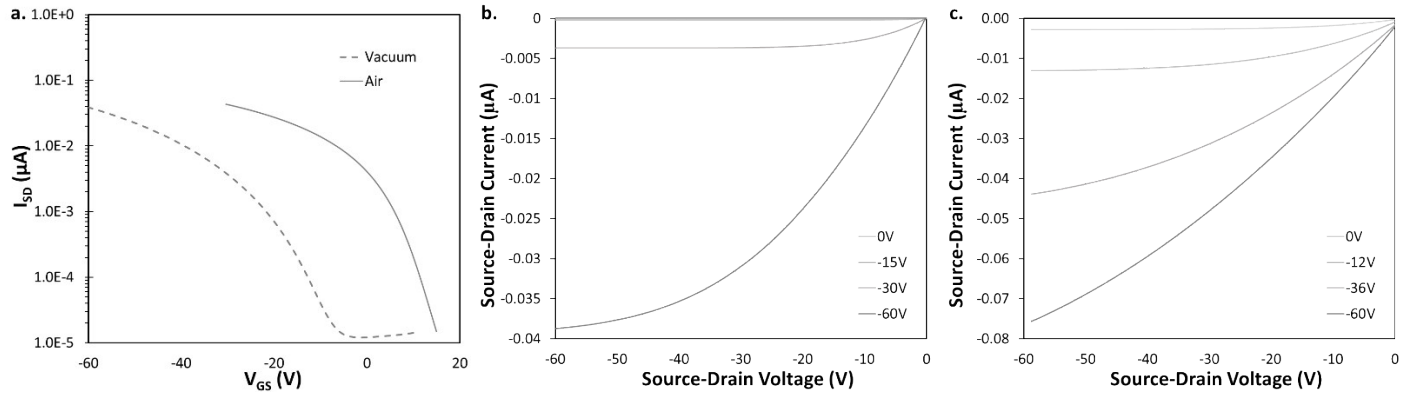


Figure S6. Characterization of ZnPc OTFTs. (a) transfer curves for ZnPc BGBC devices deposited at  $T = 140^\circ\text{C}$ , and tested in air, and vacuum, at  $T = 25^\circ\text{C}$ . Output curves for identical devices in b) air c) and vacuum.

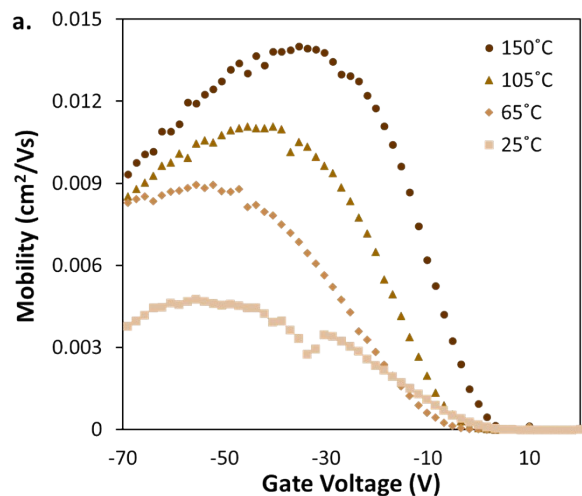


Figure S7. Field-effect mobility for FePc BGBC devices, deposited at  $T = 140^\circ\text{C}$  and tested in vacuum (a), with respect to applied gate-source voltage ( $V_{\text{GS}}$ ) for characteristic devices at varied temperatures. This mobility was calculated between adjacent points in the transfer data using equation 2. Devices were tested in the range  $T = 25^\circ\text{C}$  to  $T = 150^\circ\text{C}$  in vacuum.

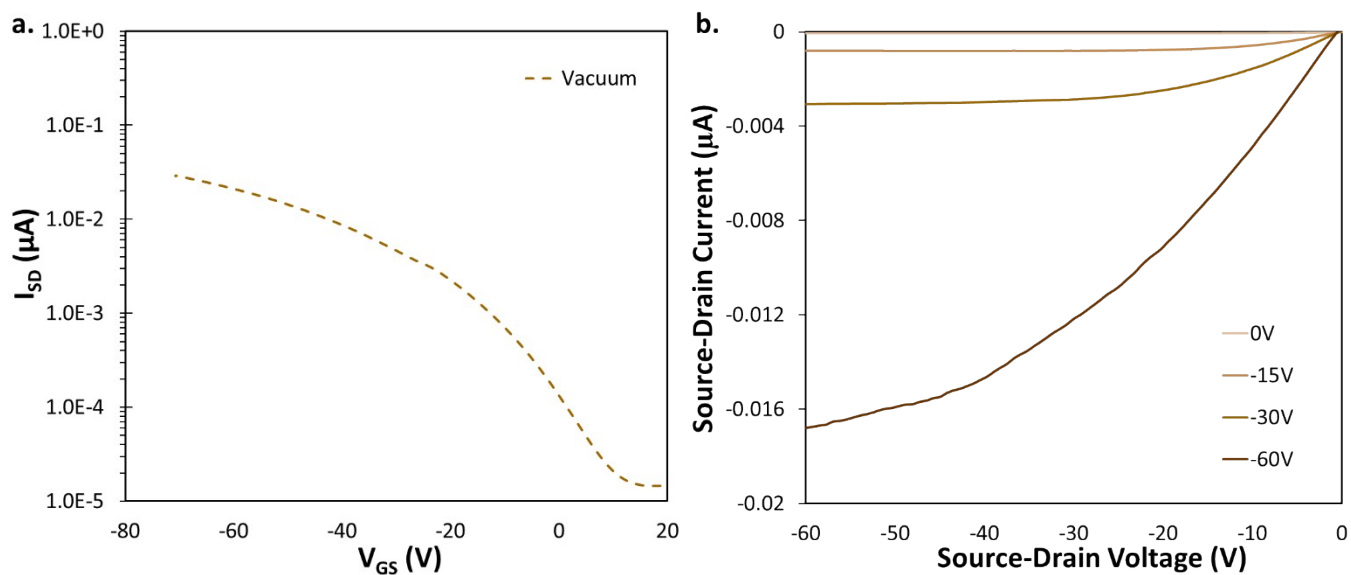


Figure S8. Characterization of FePc OTFTs. (a) transfer curves for FePc BGBC devices deposited at  $T = 140^\circ\text{C}$ . Tested in vacuum, at  $T = 25^\circ\text{C}$ . Output curves for same devices and vacuum (b).

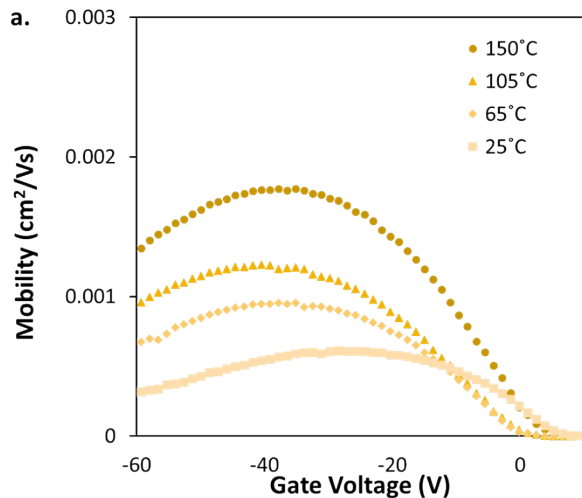


Figure S9. Field-effect mobility for MgPc BGBC devices, deposited at  $T = 140^\circ\text{C}$  and tested in vacuum (a), with respect to applied gate-source voltage ( $V_{GS}$ ) for characteristic devices at varied temperatures. This mobility was calculated between adjacent points in the transfer data using equation 2. Devices were tested in the range  $T = 25^\circ\text{C}$  to  $T = 150^\circ\text{C}$  in vacuum.

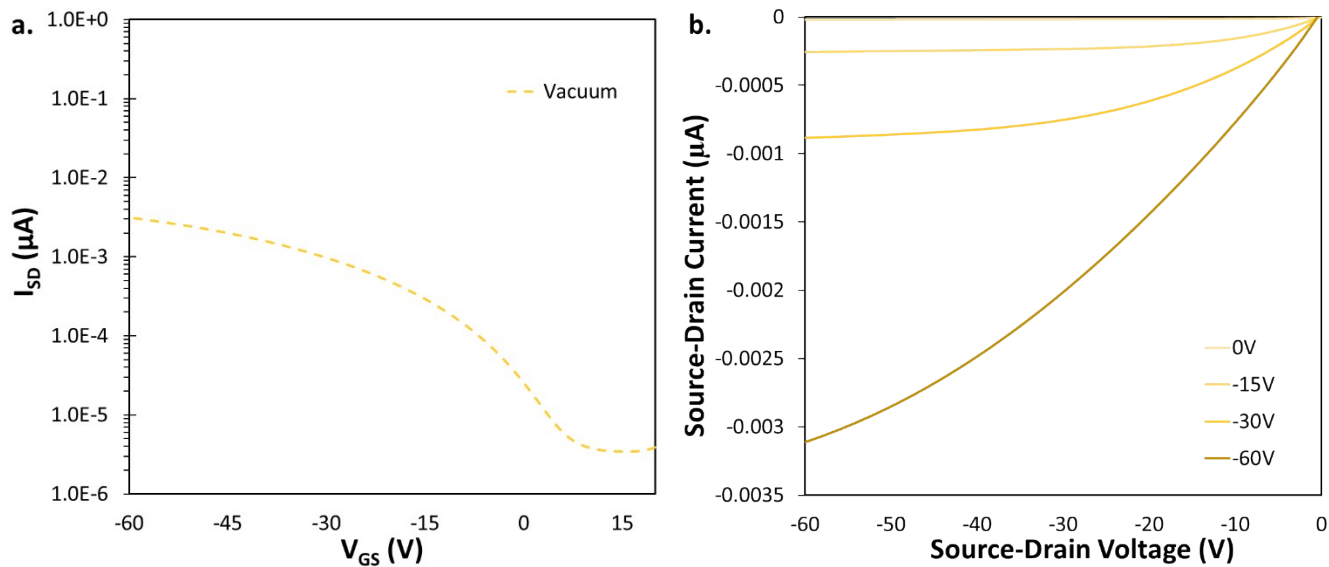


Figure S10. Characterization of MgPc OTFTs. (a) transfer curves for FePc BGBC devices deposited at  $T = 140^\circ\text{C}$ . Tested in vacuum, at  $T = 25^\circ\text{C}$ . Output curves for same devices and vacuum (b).

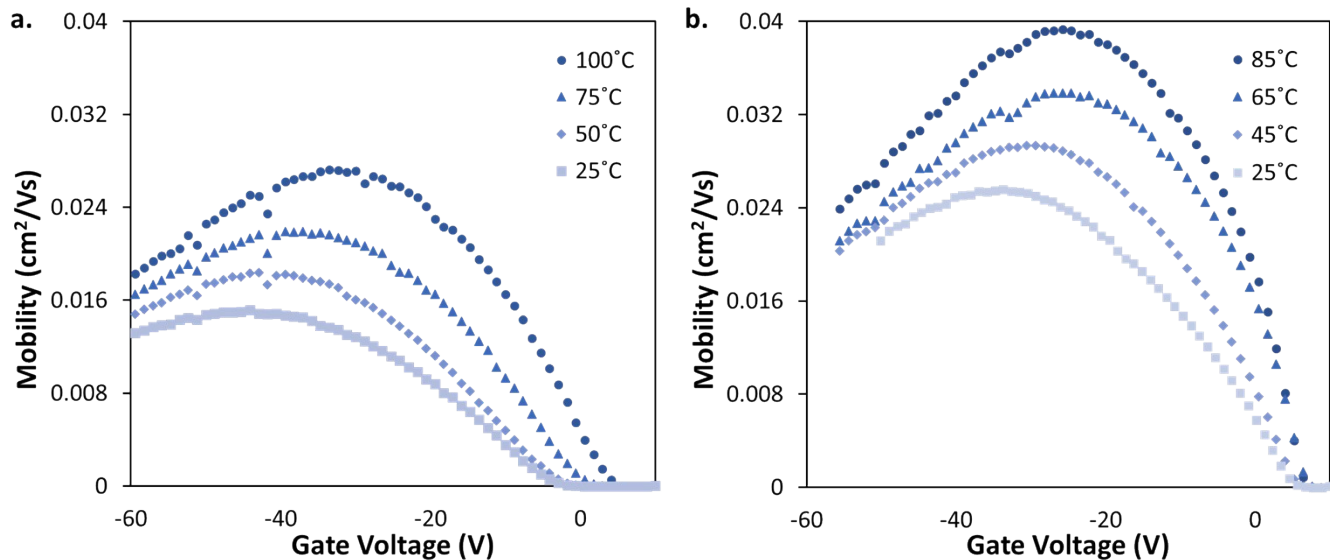


Figure S12. Field-effect mobility for CuPc BGBC devices, deposited at  $T = 140^\circ\text{C}$  and tested in vacuum (a) air (b), with respect to applied gate-source voltage ( $V_{GS}$ ) for characteristic devices at varied temperatures. This mobility was calculated between adjacent points in the transfer data using equation 2. Devices were tested in the range of  $T = 25^\circ\text{C}$  to  $T = 85^\circ\text{C}$  in air and  $T = 25^\circ\text{C}$  to  $T = 150^\circ\text{C}$  in vacuum. Data for CuPc devices was taken from a previous publication by our group.<sup>24</sup>

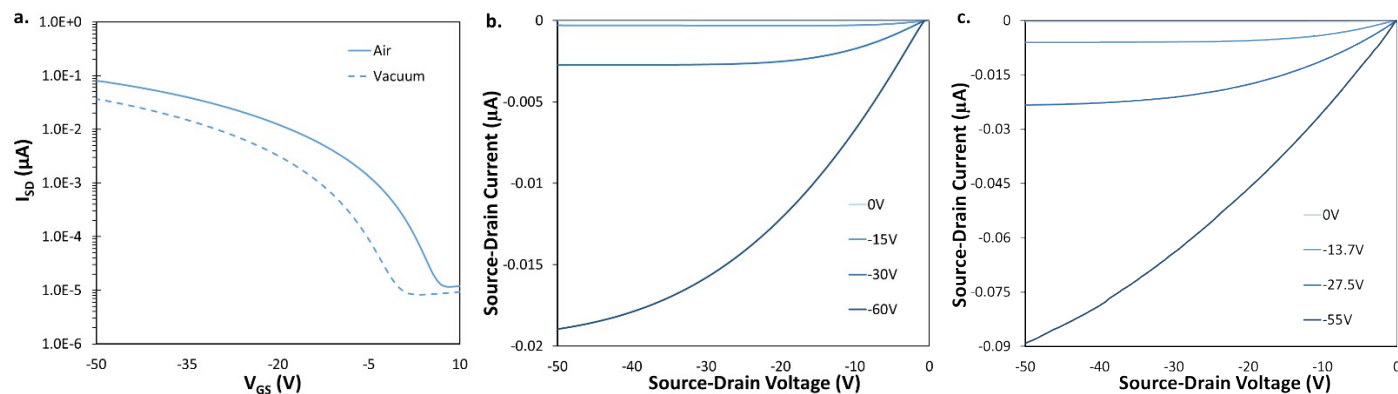


Figure S13. Characterization of CuPc OTFTs. (a) transfer curves for CuPc BGBC devices deposited at  $T = 140^\circ\text{C}$ , and tested in air, and vacuum, at  $T = 25^\circ\text{C}$ . Output curves for identical devices in vacuum (b) and air (c). Data for CuPc devices was taken from a previous publication by our group.<sup>24</sup>

Figures S14-S20 show thermogravimetric analysis curves for each material in both air and nitrogen environments.

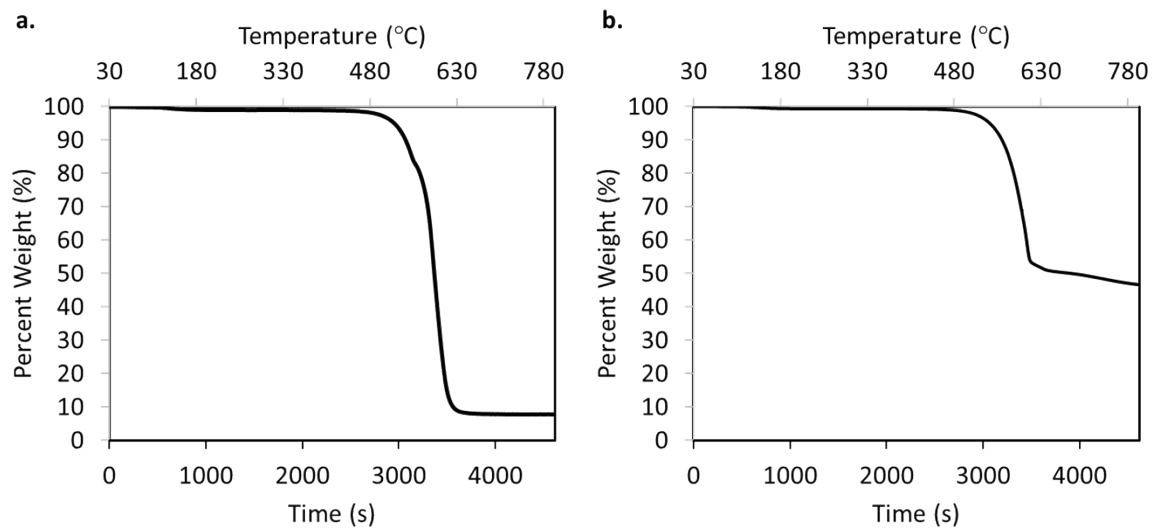


Figure S14. AIClPc TGA analysis in (a) air and (b) nitrogen environment from 30 °C to 800 °C at a 10 °C /minute ramp rate.

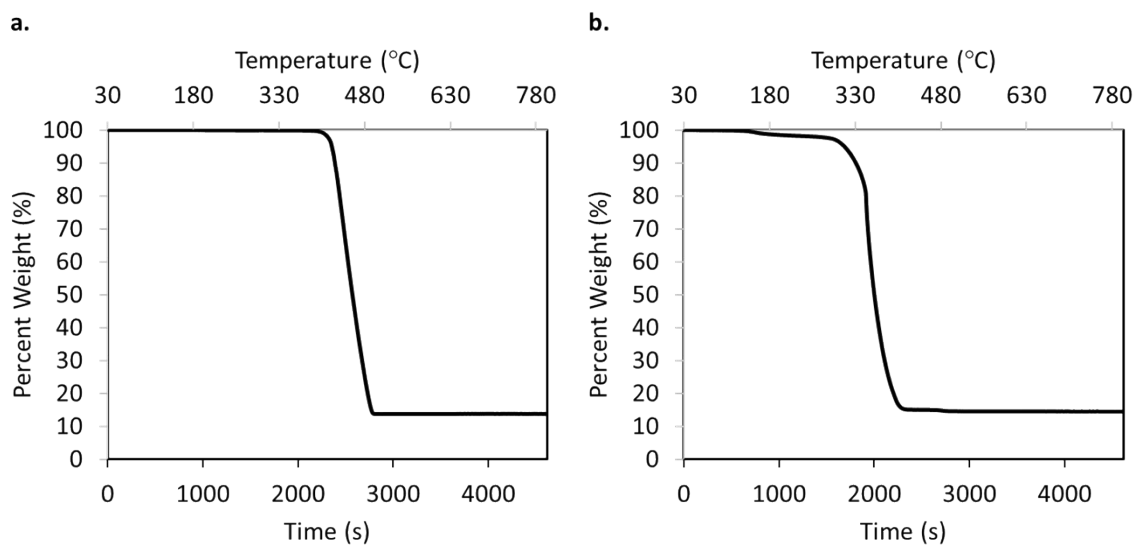


Figure S15. CoPc TGA analysis in (a) air and (b) nitrogen environment from 30 °C to 800 °C at a 10 °C /minute ramp rate.



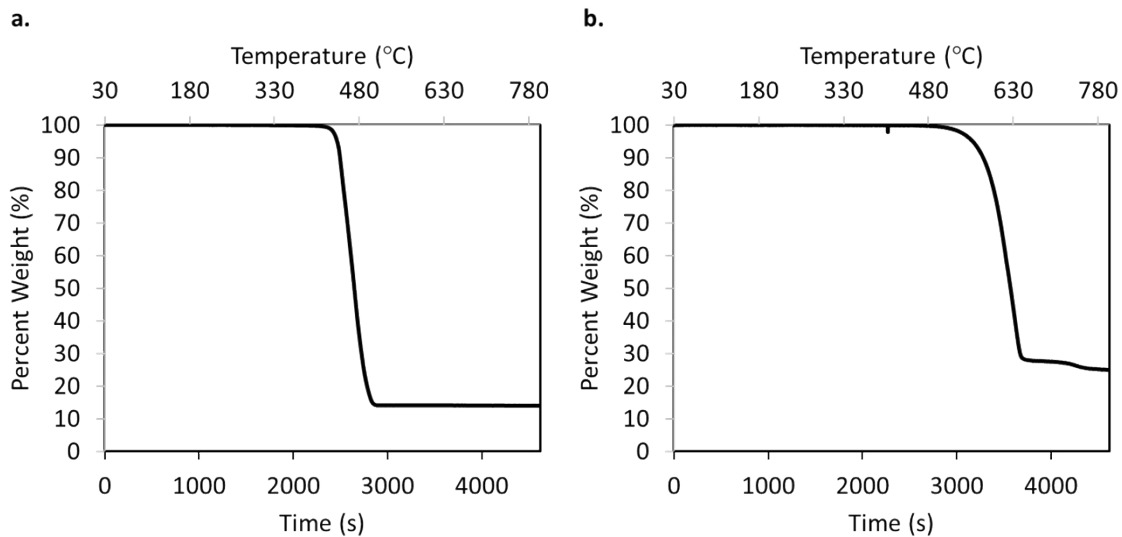


Figure S16. CuPc TGA analysis in (a) air and (b) nitrogen environment from 30 °C to 800 °C at a 10 °C/minute ramp rate.

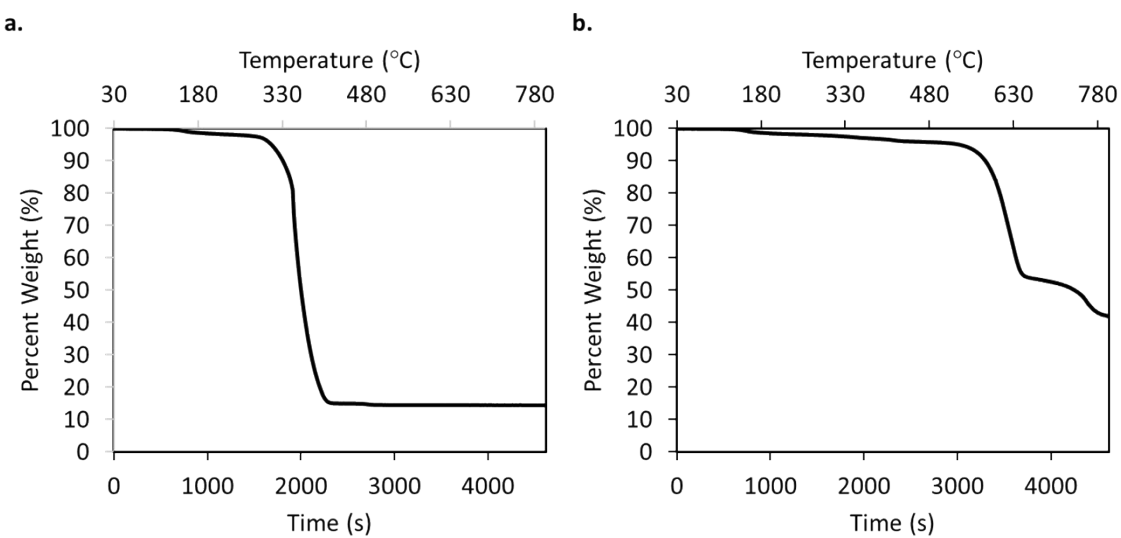


Figure S17. FePc TGA analysis in (a) air and (b) nitrogen environment from 30 °C to 800 °C at a 10 °C/minute ramp rate.

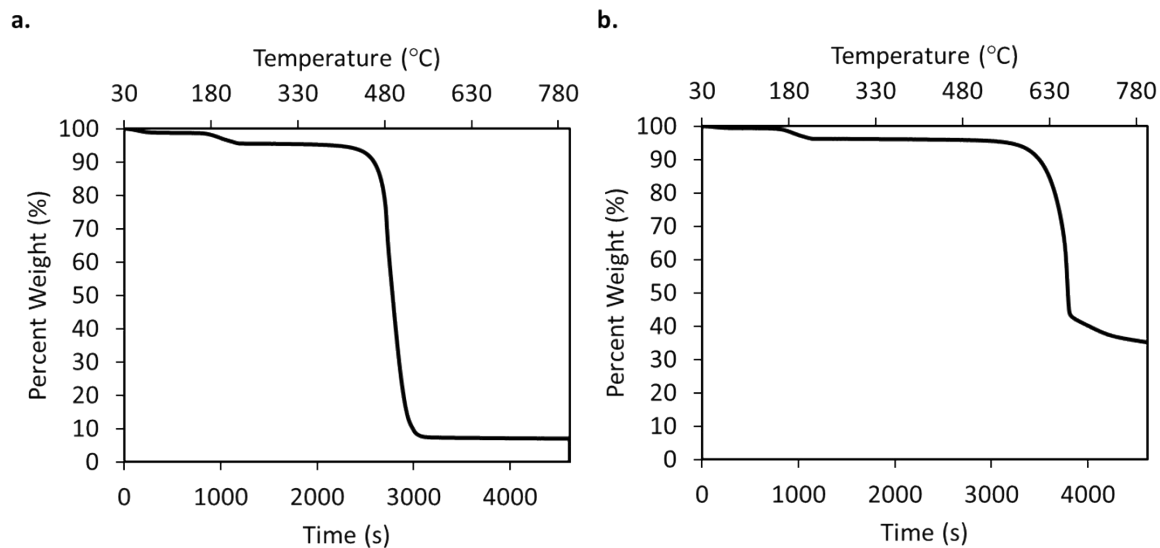


Figure S18. MgPc TGA analysis in (a) air and (b) nitrogen environment from 30 °C to 800 °C at a 10 °C/minute ramp rate.

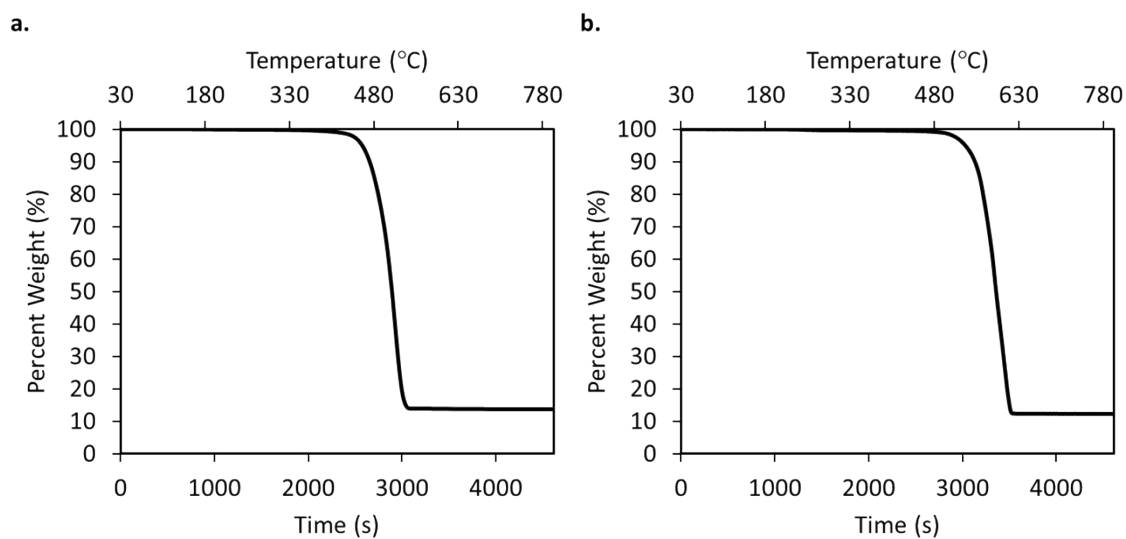


Figure S19. TiOPc TGA analysis in (a) air and (b) nitrogen environment from 30 °C to 800 °C at a 10 °C/minute ramp rate.

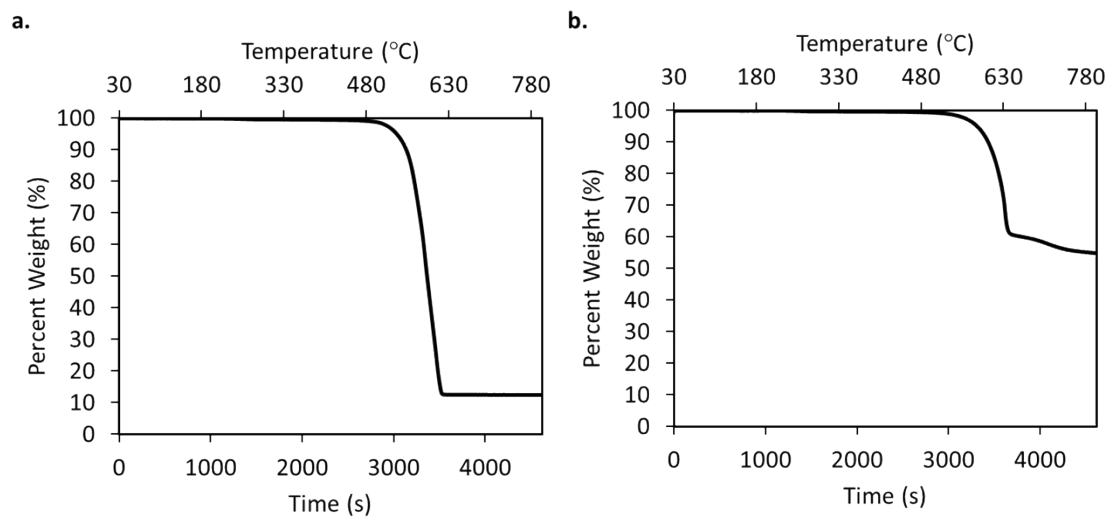


Figure S20. ZnPc TGA analysis in (a) air and (b) nitrogen environment from 30 °C to 800 °C at a 10 °C/minute ramp rate.