Dataset for '3D Printing of Customizable Transient Bioelectronics and Sensors'

Nicolas Fumeaux and Danick Briand

Soft transducers laboratory (LMTS), EPFL, Switzerland

nicolas.fumeaux@epfl.ch, danick.briand@epfl.ch

This data set contains the data collected during the FNS project Green Piezo (Grant no. 179064) in association with the publication titled '3D Printing of Customizable Transient Bioelectronics and Sensors'.

The data set consists of the following folders:

- 1: Material characterization
- 2: Printing behavior
- 3: Demonstrators
- 4: Designs

Below is a detailed description of the file naming conventions and folder contents.

File naming conventions

The data in this dataset stems from various recording modalities, experiments, designs and devices, and the detailed file naming conventions for each experiment type are described below. In general, the files are named according to the following convention: [Date]_[Experiment]_[Experiment modality]_[Additional info]. Underscores separate hiererarchical information about the data file while dashes are used to separate words within said information category. The date is formatted as follow: YYYYMMDD. The date is omitted in case the additional info about the sample is too long, and further precisions are given in a metadata file ('INFO.txt') in the same folder if appropriate.

File types

The following data types are present in the dataset. All data types can be accessed and analyzed with open-source software.

`.csv`: The data is comma delimited and can be opened with any text editor. *.csv* data files in this dataset contain headers where relevant information to the file are given (e.g. UNIX timestamp marking the beginning of data acquisition). The data is organised in columns where the first line represents the label for the columns. The rows in the data represent different samples or different timepoints, as indicated in the header.

`.txt`: As for the csv files, they can be opened with any text editor. The data is delimited by spaces, tabs or commas and the quantities and units of measurements are indicated in the columns.

`.dxf`: Drawing Exchange Format files that contain 2D designs for printed carbon electrodes. They can be opened with a vector files editor such as Inkscape.

`.stl`: STereoLithography files that contain 3D designs for the printed POMaC and carbon devices. They can be opened with any 3D files viewer or slicing software.

---

01 Material characterization

This folder contains the experiments related to the characterization of the materials and inks used in this study, i.e. of POMaC pre-polymer and polymer, as well as the carbon-shellac ink.

01 Rheology

Experiments studying the rheological properties of the POMaC pre-polymer as printed, and under illumination as described in the paper's methods.

02 Pull testing

Experiments studying the stress-strain behavior of photocured POMaC after further oven curing at 80 °C for respectively 0, 24 and 48h.

03 Bending

Experiments on the evolution of the electrical conductivity of printed carbon lines on POMaC under respectively static bending down to a radius of 1.5 mm and cyclic bending at a radius of 3 mm.

04 Degradation

Measurements of the evolution of the weight of respectively POMaC and carbon-shellac samples in phosphate-buffered saline at 37 °C.

02 Printing behavior

This folders contains the data for experiments related to study of the printability of the inks described above with a nozzle of 125 microns internal diameter. The other parameters are indicated as needed and the detail of the experiments is shown below.

01 Lines

The printing behavior of POMaC pre-polymer is studied while varying the inlet pressure, dispense gap and printing speed and measuring the 3D topography of the printed lines with a confocal laser microscope afterspot UV curing. The data each contains the scan of several lines for which the dispense parameters are indicated in the file title, as outlines in the associated INFO.txt file.

02 Layers

Building upon the above experiment, single layers of POMaC are printed with different line spacings (indicated as detailed in the associated INFO.txt file) and measured with the confocal laser microscope as above.

03 Demonstrators

This folder contains the data for the characterization of the physical and electrical sensors that were fabricated as demonstrators of the possibilities of using this 3D printing optimization to fabricate functional transient devices.

01 Pressure sensors

Charaterization of the fabricated pressure sensors in terms of capacitance as a function of applied load, with the following naming convention: pressure_[Low force]_[High force]_[(optional) Frequency]_[Experiment type]_[(optional) Additional info]_(sample number). More detail is given in the associated INFO.txt metadata file.

02 Strain sensors

Charaterization of the fabricated strain sensors as a function of applied displacement, with the following naming convention: strain_[Low elongation %]_[High elongation %]_[Elongation step %]_[Number of repetitions]_[Data type]. Data type refers to 'force' (containing the load in N and the displacement in mm) or 'resistance' (containing the electrical resistance of the sensor in Ohm). More detail is given in the associated INFO.txt metadata file.

03 Electrophysiology electrodes

Characterization of the fabricated electrodes in terms of impedance behavior in PBS solution. More detail is given in the associated INFO.txt metadata file.

04 Designs

This folders contains the designs that were used for the 3D printing of the transient devices and demonstrators.

01 Dogbone

STL file for the dogbone shape of height 0.5 mm that was used in the pull tests.

02 Electrodes

STL files for an 8 electrodes array with encapsulation and electrode openings.

03 Lines

STL files for a device consisting of 8 parallel carbon lines encapsulated in POMaC, except for contacts on both sides, used for static and cyclic bending tests.

04 Pressure

STL files for the parallel plate capacitor that is used as a capacitive pressure sensor demonstrator in this publication.

05 Strain

STL and DXF files for the meshed resistor design that was used as a stretchable interconnect/strain sensor demonstrator. The carbon lines are provided as STL, which is also compatible with the printer system used in the publication.