The datasets presented here belong to an investigation of a hybrid material of porous silicon and the electrically conductive polymer Polypyrrole. The Polypyrrole is filled into the pores of the porous silicon by an electrochemical polymerization process. The resulting sample is depicted in the TEM graphic uploaded in the dataset. The homogenous filling of the silicon pores is visible. The sample is then inserted into an aqueous electrolyte solution of 1 molar perchloric acid and electrically contacted. When a potential in the capacitive region of the sample (0.4 V - 0.9 V) is applied between the sample and a counter electrode, anions are inserted or removed from the polymer. Subsequently, the polymer expands or contracts respectively. This reaction upon a linear changing potential (a *Cyclic Voltammetry* measurement) in the potential is recorded in-situ by a dilatometer setup. The respective data of this measurement is in the file “CV-strain measurement.txt” – the potential, the inserted charge of the anions and the caused strain.

Additionally, the sample is characterized electrochemically. The capacity of the sample can be determined by choosing different so called sweep rates, which is the rate of change in the linear potential, while recording the ensuing current. When plotting the maximal current against the sweep rate, the slope of a linear fit to the data equals the capacity. This data can be found in the file “CV – Scan rate measurements.txt”.

Then, instead of a linearly changing potential, a square potential has been applied and the induced charge and strain are measured once more. These data can be found in file “step coulometry – strain measurement.txt”. This measurement method allows to determine the dynamics of the electroactuation. By fitting a simple exponential function to the measured charge and the strain, the characteristic time constant of the respective process can be extracted.

Lastly, the electroactuation process is micromechanically modelled as well. Therefore, the TEM picture described above is transferred into a FEM model with a porous silicon skeleton and a Polypyrrole filling in the pore space. In order to identify which part of the TEM picture equals porous silicon and which part Polypyrrole, the grayvalue of the picture is utilized. In a study the respective grayvalue, which is assigned to the Polypyrrole is subsequently changed and the resulting Young’s modulus of the model is determined by means of an FEM simulation for two different silicon orientations – 0° and 45°. The actual, measured Young’s modulus of the hybrid material can then be use to set the appropriate grayvalue for the model. This whole study along a “readme”-file can be found in the folder “Micromechanical Analysis”.