

## Description of Additional Supplementary Files

File Name: Supplementary Movie 1

Description: **Mono-enzymatic actuation measurements (real time).** Autonomous bioelectrochemical actuation of (left side) a Ppy/DBS/GOx film in a 0.3 M PBS (pH = 5), 1 mM glucose solution and (right side) a Ppy/DBS/BOD film in a 0.3 M PBS solution at 25°C (pH = 5) saturated with O<sub>2</sub>.

File Name: Supplementary Movie 2

Description: **Bi-enzymatic actuation as a function of glucose concentration (x2 accelerated).** Self-sustained enzymatic electromechanical actuation as a function of glucose concentration of a modified bi-enzymatic Ppy/DBS films in a 0.3 M PBS solution at 25°C (pH = 5) saturated with O<sub>2</sub>.

File Name: Supplementary Movie 3

Description: **Lateral motion of an asymmetrically modified bioelectrochemical actuator strip 1 (x5 accelerated).** Lateral motion of an asymmetrically modified Ppy/DBS film immersed in a 0.3 M PBS at 25°C (pH = 5), 5 mM glucose solution, saturated with O<sub>2</sub>.

File Name: Supplementary Movie 4

Description: **Lateral motion of an asymmetrically modified bioelectrochemical actuator strip 2 (x5 accelerated).** Lateral motion of an asymmetrically modified Ppy/DBS film with a shorter region of electroactive Ppy and an inverted orientation immersed in a 0.3 M PBS at 25°C (pH = 5), 5 mM glucose solution, saturated with O<sub>2</sub>.

File Name: Supplementary Movie 5

Description: **Double pulse potentiostatic actuation of Ppy (x10 accelerated).** Electromechanical actuation of a free-standing Ppy/DBS film in a 0.1 M LiClO<sub>4</sub> solution; oxidation potential 0.8 V vs Ag/AgCl, reduction potential -0.8 V vs Ag/AgCl and pulse time 10 seconds.

File Name: Supplementary Movie 6

Description: **Long distance lateral motion of an asymmetrically modified bioelectrochemical actuator strip (x10 accelerated)**

Top view of a long distance motion of an asymmetrically modified Ppy/DBS film with a short region of electroactive Ppy in a 0.3 M PBS at 25°C (pH = 5), 5 mM glucose solution, saturated with O<sub>2</sub>.