

Electronic Supplementary Information

**Electrochemical performance at sputter-deposited nanocarbon film with
different surface nitrogen-containing groups**

Tomoyuki Kamata,^a Dai Kato^{a*} and Osamu Niwa^{b*}

^aNational Institute of Advanced Industrial Science and Technology, 1-1-1 Higashi, Tsukuba,
Ibaraki 305-8566, Japan

^bSaitama Institute of Technology, Fusaiji, 1690, Fukaya, Saitama 369-0293 Japan

[*dai.kato@aist.go.jp](mailto:dai.kato@aist.go.jp)

[*niwa@sit.ac.jp](mailto:niwa@sit.ac.jp)

Resistivities of pure-UBM, GL-UBM and PL-UBM carbon films.

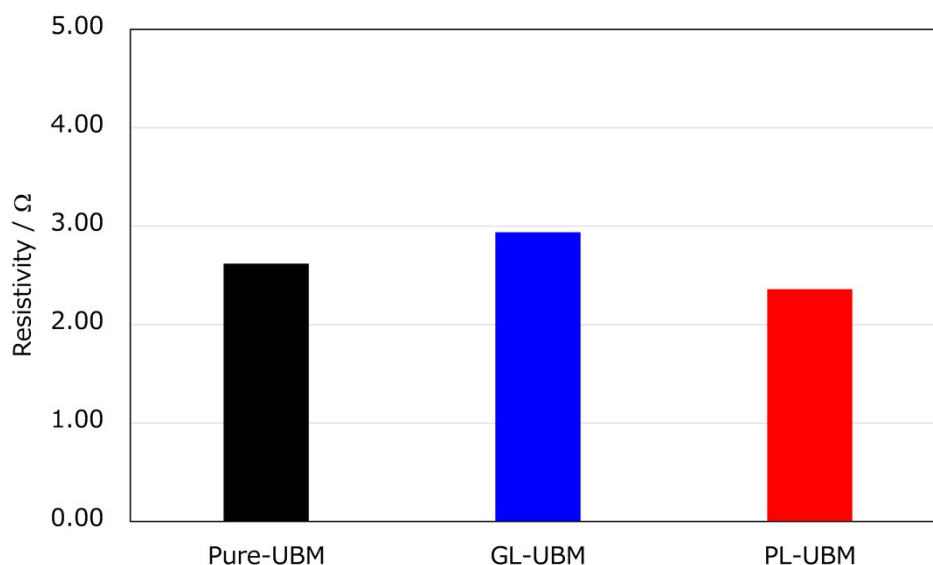


Fig. S1. Resistivities of pure-UBM, GL-UBM (N=4 at%) and PL-UBM (N=4 at%) carbon films by four-terminal method.

Basic Electrochemical Properties of pure-UBM, GL-UBM and PL-UBM electrodes.

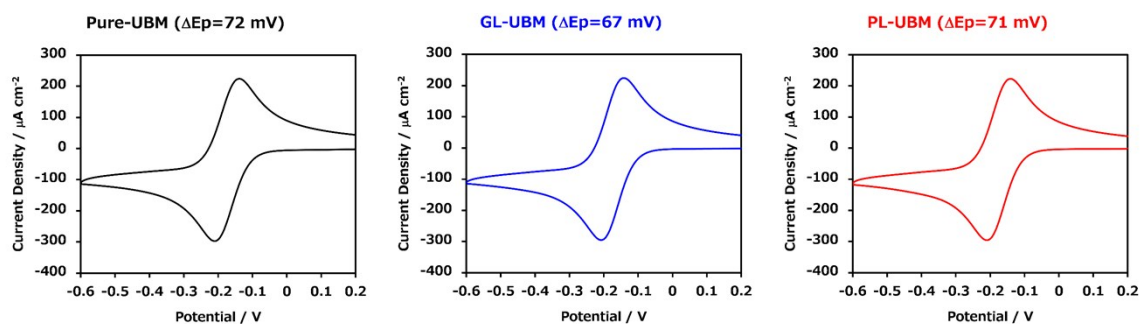


Fig. S2. CVs of pure-UBM, GL-UBM (N=4 at%) and PL-UBM (N=4 at%) electrodes in 1.0 mM $\text{Ru}(\text{NH}_3)_6^{+3}$ in 1.0 M KCl. Scan rate; 0.1 V/s.

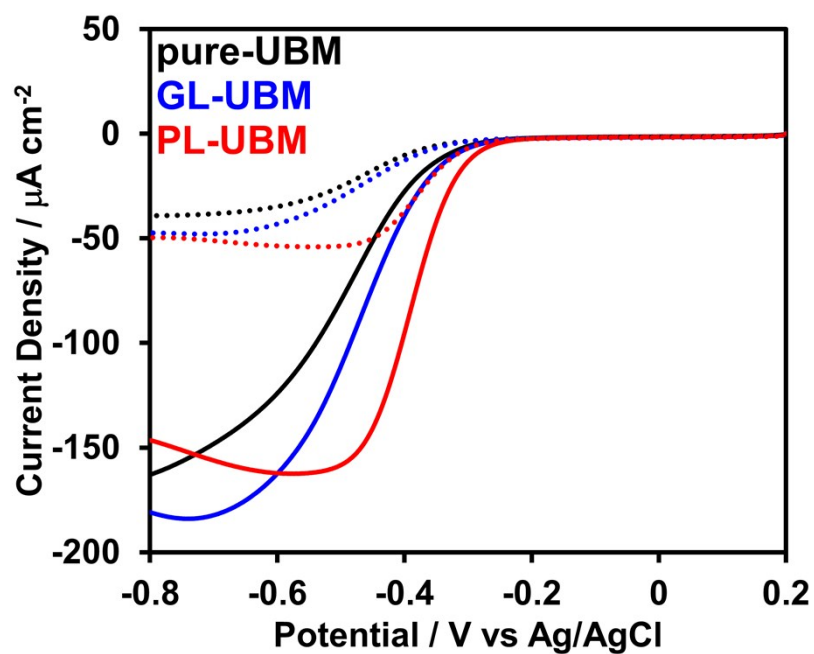


Fig. S3. CVs of pure-UBM, GL-UBM (N=4 at%) and PL-UBM (N=4 at%) electrodes for ORR in O_2 saturated 0.1 M KOH. Dotted lines are background scan. Scan rate; 0.05 V/s.

Oxygen Reduction

Effect on Electrochemical Oxidation for Biomolecule

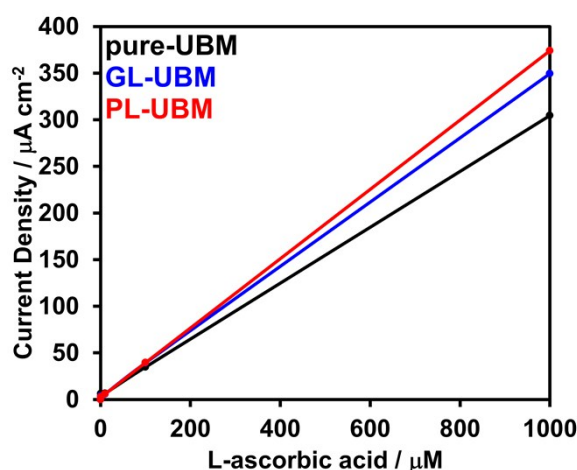


Fig. S4. Calibration lines of L-ascorbic acid at pure-UBM, GL-UBM (N=4 at%) and PL-UBM (N=4 at%) electrodes. Concentration range is from 1 to 1000 μM .

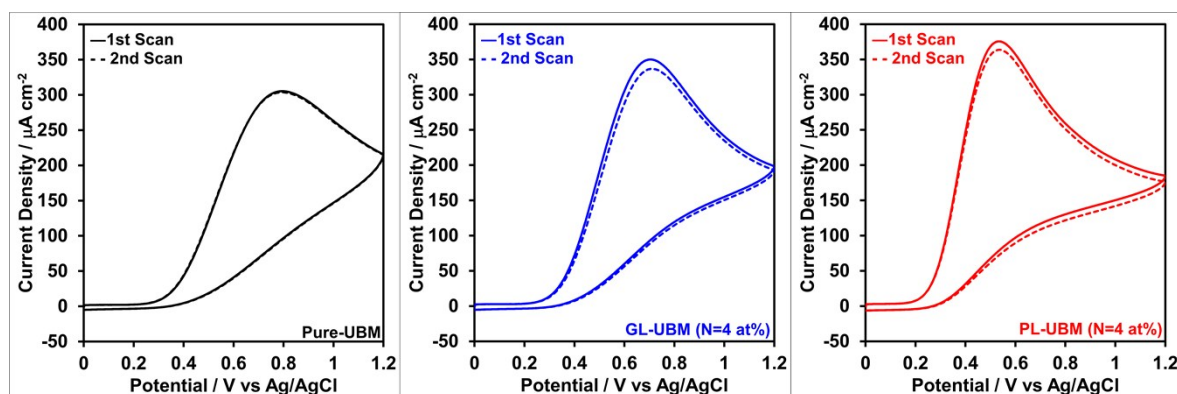


Fig. S5. CVs of 1.0 mM L-ascorbic acid at pure-UBM, GL-UBM (N=4 at%) and PL-UBM (N=4 at%) electrodes measured in 1.0 M NaNO_3 . The solid and dotted lines represent 1st and 2nd scan, respectively.

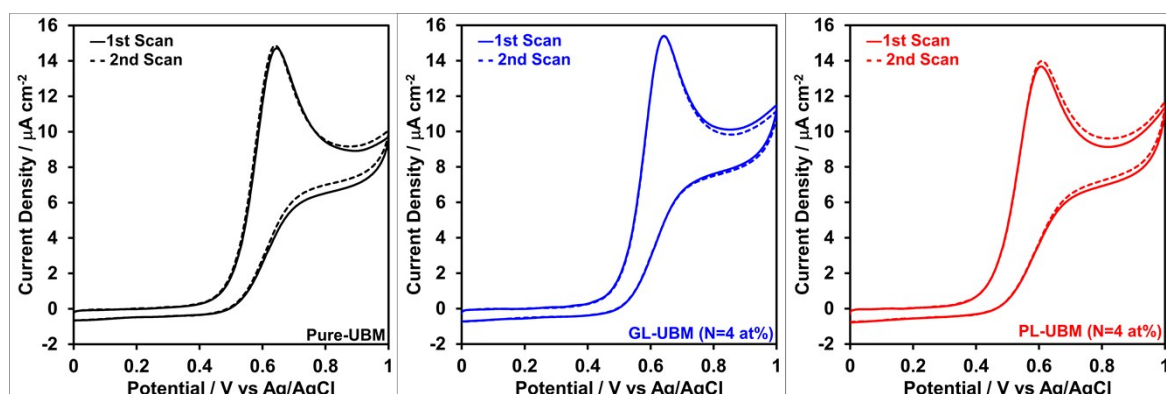


Fig. S6. CVs of 0.1 mM NADH at pure-UBM, GL-UBM (N=4 at%) and PL-UBM (N=4 at%) electrodes measured in 0.1 M phosphate buffer (pH=8.2). The solid and dotted lines represent 1st and 2nd scan, respectively.