

## LIST ABBREVIATIONS AND SYMBOLS USED

$a$	Degree of polymerization
$A$	Area of the electrode
$A^-$	Negative ions
AFM	Atomic force microscopy
Ag	Silver
$AgNO_3$	Silver nitrate
AgNR	Silver nanorod
APS	Ammonium peroxydisulphate
ASC	Asymmetric supercapacitor
Au	Gold
BET	Brunauer-Emmett-Teller
BJH	Barrett-Joyner-Halenda
$c_i$	Concentration of species $i$
c-MWCNT	Carboxylated multi-walled carbon nanotube
C	Carbon
$C$	Capacitance
[C]	Molar concentration of the analyte
$Ca^{2+}$	Calcium (II) ions
CB	Carbon black
CD	Carbon dot
CE	Counter electrode
$C_{EDL}$	Electrochemical double layer capacitance
$C_F$	Faradaic capacitance
$CH_3OH$	Methanol
$ClO^-$	Hypochlorite ions
$ClO_2$	Chlorine dioxide
CND	Carbon nanodot
CNS	Central nervous system
CNT	Carbon nanotube
CO	Carbon monoxide
$CO_2$	Carbon dioxide
CQD	Carbon quantum dot
$Cr^{3+}$	Chromium (III) ions
$Cr^{6+}$	Chromium (VI) ions
$C_{sp}$	Specific capacitance

$\text{Cu}^{2+}$	Copper (II) ions
CV	Cyclic voltammetry
CVD	Chemical vapor deposition
$d$	Distance between the plates
2,4-DNP	2,4-Dinitrophenol
2,6-DNT	2,6-Dinitrotoluene
DFT	Density functional theory
DMF	<i>N,N</i> -Dimethylformamide
DMFC	Direct methanol fuel cell
DNA	Deoxyribonucleic acid
DSSC	Dye sensitized solar cell
$e^-$	Electron
$E$	Energy density
$E'$	Energy stored in a capacitor
$E''$	Potential
$E_o$	Standard potential
EASA	Electrochemical active surface area
$E_C$	TiO <sub>2</sub> conduction band edge
EDL	Electrochemical double layer
EDLC	Electrochemical double layer capacitor
EDX	Energy dispersive X-ray spectrometry
$E_F$	Fermi level of the photo-anode
$E_{g,op}$	Optical band-gap
$E_{HOMO}$	HOMO energy level
EIS	Electrochemical impedance spectroscopy
$E(k)$	Graphene energy
$E_{LUMO}$	LUMO energy levels
$E_{onset,ox}$	Onset oxidation potential
$E_{onset,red}$	Onset reduction potential
$E_P$	Peak current
$E_{PP}$	Peak to peak separation
$E_{redox}$	Redox potential of the electrolyte
ESR	Electrochemical series resistance
F	Formaldehyde
FCN	Fluorescent carbon nanoparticle
$\text{Fe}^{3+}$	Ferric (III) ions
$\text{FeCl}_3$	Ferric chloride

<i>FF</i>	Fill factor
FRET	Fluorescence resonance energy transfer
FTIR	Fourier transform infra-red spectroscopy
FTO	Fluorine doped tin oxide
GCD	Galvanostatic charge-discharge
GGA	Generalized gradient approximation
GIC	Graphite intercalated compound
GQD	Graphene quantum dot
GO	Graphene oxide
H <sup>+</sup>	Proton
H <sub>2</sub>	Hydrogen
H <sub>2</sub> O	Water
H <sub>2</sub> O <sub>2</sub>	Hydrogen peroxide
H <sub>2</sub> PtCl <sub>6</sub>	Chloroplatinic acid
H <sub>2</sub> SO <sub>4</sub>	Sulfuric acid
HCHO	Formaldehyde
HCl	Hydrochloric acid
Hg <sup>2+</sup>	Mercury (II) ions
HNO <sub>3</sub>	Nitric acid
HOMO	Highest occupied molecular orbital
HOPG	Highly ordered pyrolytic graphite
HRTEM	High resolution transmission electron microscopy
HTA	2-Hydroxyterephthalic acid
<i>i</i>	PL intensity after addition of the analyte
<i>I</i>	Current
<i>I'</i>	Voltammetric current
<i>I''</i>	Discharge current
I <sup>-</sup>	Iodide ions
<i>i<sub>o</sub></i>	PL intensity before addition of the analyte
I <sub>2</sub>	Iodine
I <sub>3</sub> <sup>-</sup>	Triiodide ions
<i>I<sub>b</sub></i>	Backward scan peak current
ICP	Intrinsically conducting polymer
<i>I<sub>f</sub></i>	Forward scan peak current
IFE	Inner filter effect
<i>I<sub>inj</sub></i>	Charge flux from an electron injection by the oxidized dye
<i>J</i>	Current density

$J_{max}$	Maximum current density
$J_{SC}$	Short-circuit current density
$k$	Quasi-particle momentum
$k'$	Boltzmann constant
$K$ and $K'$	Dirac points
$K_3[Fe(CN)_6]$	Potassium ferricyanide
$K_4[Fe(CN)_6]$	Potassium ferrocyanide
$KClO_3$	Potassium chloride
$k_{et}$	Rate constant for the reduction of $I_3^-$ by the conduction band electrons
$KMnO_4$	Potassium permanganate
$K_{SV}$	Stern-Volmer quenching constant
LDH	Layered double hydroxide
LE	Liquid electrolyte
$LiClO_4$	Lithium perchlorate
$LiI$	Lithium iodide
LOD	Limit of detection
LPP	Long-persistence phosphor
LUMO	Lowest unoccupied molecular orbital
$m'$	Mass of active element in the electrodes
M	Molecular weight of the active material
$Mg^{2+}$	Magnesium (II) ions
$MnO_2$	Manganese dioxide
$MnSO_4$	Manganese sulfate
MOR	Methanol oxidation reaction
$m_{Pt}$	Pt loading on the working electrode
MPI	1-Methyl-3-propylimidazolium iodide
MWCNT	Multi-walled carbon nanotube
$n'$	Number of electrons involved in the redox reaction
$n_o$	Electron concentration at the $TiO_2$ surface in the dark
$N_2H_4$	Hydrazine
N3	<i>Cis</i> -bis(isothiocyanato)bis(2,2'-bipyridyl-4,4'-dicarboxylato)ruthenium(II)
N719	Di-tetrabutylammonium <i>cis</i> -bis(isothiocyanato)bis(2,2'-bipyridyl-4,4'-dicarboxylato)ruthenium(II)
$Na_2CO_3$	Sodium carbonate
$Na_2S$	Sodium sulfide
$NaBH_4$	Sodium borohydride
NAC	Nitroaromatic compound

NaNO <sub>3</sub>	Sodium nitrate
NaOH	Sodium hydroxide
$n_C$	Free electron density in the conduction band of TiO <sub>2</sub>
$N_C$	Density of accessible states in the conduction band of TiO <sub>2</sub>
NH <sub>3</sub>	Ammonia
NH <sub>4</sub> OH	Ammonium hydroxide
NiCo <sub>2</sub> O <sub>4</sub>	Nickel cobaltite
NiO	Nickel oxide
Ni(OH) <sub>2</sub>	Nickel hydroxide
NMP	N-methyl-2-pyrrolidone
NO <sub>2</sub>	Nitrogen dioxide
O <sub>2</sub>	Oxygen
O <sub>2</sub> <sup>-</sup>	Superoxide anions
ODNS	One-dimensional nanostructure
$p$	Power coefficient of indirect allowed electronic transitions
PA	Polyacetylene
PAH	Polyaromatic hydrocarbon
PAni	Polyaniline
PAniNT	Polyaniline nanotube
Pb <sup>2+</sup>	Lead (II) ions
PEDOT	Poly(3,4-ethylene-dioxythiophene)
PEI	Polyethylenimine
PET	Photo-induced electron transfer
PGE	Polymer gel electrolyte
$P_m$	Incident light power
PL	Photoluminescence
PMMA	Poly(methyl methacrylate)
p-NP	p-Nitrophenol
PPV	Poly(phenyl vinylene)
PPy	Polypyrrole
Pt	Platinum
PTh	Polythiophene
PtI <sub>4</sub>	Platinum iodide
PVA	Poly(vinyl alcohol)
PVP	Polyvinylpyrrolidone
$q$	Charge
$q'$	Charge of the electron

$q_H$	Electrical charge of hydrogen adsorption/desorption obtained from the integrated cyclic voltammetric peak area after double layer correction
QS	Quinine sulfate
$R$	Resistance
R	Resorcinol
$R'$	Universal gas constant
$R_b$	Bulk resistance of the electrolyte
$R_c$	Contact resistance at the interface of the active material, the electrolyte and the current collector
$R_{CT}$	Charge transfer resistance
$R_{CT,CE}$	Charge transfer resistance at the interface of the counter electrode and electrolyte
$R_{CT,PE}$	Charge transfer resistance at the interface of the photoanode and electrolyte
rGO	Reduced graphene oxide
rGOA	Reduced graphene oxide aerogel
$R_H$	Relative humidity
$R_m$	Intrinsic resistance of the active material
$R_S$	Internal series resistance
$RuO_2$	Ruthenium dioxide
$s$	Slope
$S$	Sensor response
SEM	Scanning electron microscopy
SiC	Silicon carbide
SQD	Semiconductor quantum dot
STM	Scanning tunneling microscopy
SWCNT	Single-walled carbon nanotube
$t$	Time required for discharge
$T$	Absolute temperature
TA	Terephthalic acid
TBP	4-Tert-butylpyridine
TEM	Transmission electron microscope
THF	Tetrahydrofuran
$TiCl_4$	Titanium tetrachloride
$TiO_2$	Titanium dioxide
TNP	2,4,6-Trinitriphenol
TNT	2,4,6-Trinitrotoluene
UV	Ultra-violet
$V$	Voltage

$V'$	Potential in one sweep segment
$V''$	Potential change after complete discharge
$v_F$	Fermi velocity
$V_{max}$	Maximum voltage
$V_{OC}$	Open-circuit voltage
VOC	Volatile organic compound
XPS	X-ray photoelectron spectroscopy
XRD	X-ray diffraction
$W$	Warburg impedance
wt%	Weight percentage
$X$	Extent of fractional coverage of the electrode surface or inner structure
$Z$	Real part of impedance
$Z'$	Imaginary part of impedance
$z_i$	Charge on species $i$
ZnO	Zinc oxide
$\alpha$	Absorption coefficient
$\epsilon_o$	Permittivity of free space
$\epsilon_r$	Relative permittivity of the dielectric medium
$\hbar$	Reduced Planck's constant
$\eta$	Photo-conversion efficiency
$\eta'$	Refractive index
$\nu$	Scan rate
$\Phi$	Quantum yield

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## Chapter 5: Hydro-/solvothermally Synthesized Carbon Dots for Different Applications

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