

List of figures

Figure I.1. General presentation of interaction potential of spheres in water	33
Figure II.1. Cyclic voltammogram of a gold electrode in 0.1M H ₂ SO ₄ at 100 mV s ⁻¹	61
Figure II.2. 1 st and 2 nd cyclic voltammograms for the reduction of the Au-S bond in the mercaptopyrindine SAM in 0.1M phosphate buffer, 0.15M NaCl, pH 6.0 at 100mV s ⁻¹	61
Figure II.3. Frequency change after oligonucleotide-thiol immobilisation (from a 1ng mL ⁻¹ solution) on a gold quartz crystal	64
Figure III.1. Absorbance vs. wavelength for thioctic acid-colloidal gold suspensions (4.5 x 10 ¹¹ particles mL ⁻¹) before and after washing and resuspension in 0.01M carbonate buffer, pH 9.3 or 0.01M phosphate buffer, pH 7.0	76
Figure III.2. Absorbance vs. wavelength for colloidal gold suspensions with different ethanol content	80
Figure III.3. Absorbance vs. wavelength for colloidal gold suspensions with different ethanol content after 24h	80
Figure III.4. Fluorescence emitted at 520nm by SN1, SN2 and SNME in the FITC-oligonucleotide-thiol-colloidal gold conjugate characterisation by mercaptoethanol for different colloidal gold concentrations and the same FITC-oligonucleotide-thiol concentration (3µM)	82
Figure III.5. Fluorescence emitted at 520nm by SN1, SN2, SN3, SN4, SN5 and SNME in the FITC-oligonucleotide-thiol-colloidal gold conjugate characterisation by mercaptoethanol for the same colloidal gold concentration (2.45 x 10 ¹² particles mL ⁻¹) and different FITC-oligonucleotide-thiol concentrations	83
Figure III.6. Absorbance at 650nm obtained in the sandwich ELONA for the dig-oligonucleotide-thiol-colloidal gold (20nm colloidal gold) conjugate characterisation	84
Figure III.7. Absorbance at 650nm obtained in the sandwich ELONA for the dig-oligonucleotide-thiol-colloidal gold (3 and 20nm colloidal gold) conjugate characterisation	85
Figure III.8. Absorbance at 650nm obtained in the hybridisation ELONA for the dig-oligonucleotide-thiol-colloidal gold (20nm colloidal gold) conjugate functionality characterization	86
Figure IV.1. Gold IDEs (5-µm width electrodes and gap) under light microscopy a) before and b) after immersion in a 5nm colloidal gold suspension in a three-electrode cell and application of +1V (vs. Ag/AgCl) for 30min at one of the sets	98
Figure IV.2. Gold IDEs (5-µm width electrodes and gap) under light microscopy after immersion in a 5nm colloidal gold suspension in a three-electrode cell, application of +1V (vs. Ag/AgCl) for 30min at one of the sets, and a) carefully rinsing or b) water-jet rinsing	98
Figure IV.3. Gold IDEs (5-µm width electrodes and gap) under electronic microscopy after immersion in a 5nm colloidal gold suspension in a three-electrode cell and	

application of +1V (vs. Ag/AgCl) for 30min at one of the sets	99
Figure IV.4. Linear sweep voltammetry at 0.05mV s^{-1} in $0.1\text{M H}_2\text{SO}_4$ after selective electrodeposition of 20nm colloidal gold by immersion of the gold IDEs in a three-electrode cell and application of +1V (vs. Ag/AgCl) for 30min at one set	99
Figure IV.5. Absorbance vs. wavelength of 20nm colloidal gold electrodeposited or adsorbed on ITO electrodes in <i>sampling</i> mode	100
Figure IV.6. Absorbance at 523nm vs. time of 5nm colloidal gold electrodeposited or adsorbed on ITO electrodes in <i>sampling</i> mode	101
Figure IV.7. Absorbance at 523nm vs. time of 20nm colloidal gold electrodeposited or adsorbed on ITO electrodes in <i>sampling</i> mode	101
Figure IV.8. Absorbance at 523nm vs. time of 5nm colloidal gold electrodeposited or adsorbed on ITO electrodes in <i>real-time monitoring</i> mode	102
Figure IV.9. Frequency vs. time for the electrodeposition of 20nm colloidal gold on gold-covered quartz crystals	103
Figure IV.10. Absorbance at 450nm from the colourimetric reaction of the electrodeposited or adsorbed HRP-colloidal gold (10nm) with TMB on carbon screen-printed electrodes	104
Figure IV.11. Cyclic voltammetry at 0.05mV s^{-1} in $0.1\text{M H}_2\text{SO}_4$ of 1.5mm diameter glassy carbon electrodes after immersion of the electrode in a three-electrode cell containing a FITC-oligonucleotide-thiol-colloidal gold (20nm) conjugate suspension (7.7×10^{11} particles mL^{-1} in 10mM phosphate buffer, 0.3M NaCl, pH 7.0) and application of +1.1V (vs. Ag/AgCl) for 2min	105
Figure IV.12. Absorbance at 650nm from the colourimetric reaction of the antidig-HRP with TMB in the sandwich ELONA on carbon screen-printed electrodes	106
Figure IV.13. Absorbance at 650nm from the colourimetric reaction of the antidig-HRP with TMB due to the electrodeposited or adsorbed dig-oligonucleotide-thiol-colloidal gold (DOTCG) (20nm) on carbon screen-printed electrodes	107
Figure IV.14. Currents obtained from the enzymatic reaction of the antidig-HRP with osmium complex due to the electrodeposited or adsorbed dig-oligonucleotide-thiol-colloidal gold (20nm) on carbon screen-printed electrodes	108
Figure IV.15. Light microscopy images of the electrodeposition of dig-oligonucleotide-thiol-colloidal gold (3nm) on photolithographed gold 3-electrode arrays	108
Figure IV.16. Light microscopy images of the electrodeposition of dig-oligonucleotide-thiol-colloidal gold (3nm) on photolithographed gold 3-electrode arrays	109
Figure IV.17. Currents obtained from the enzymatic reaction of the streptavidin-HRP with osmium complex due to the electrodeposited or adsorbed dig-oligonucleotide-thiol-colloidal gold (20nm) on carbon screen-printed electrodes and subsequent hybridization	110
Figure V.1. Chemical structure of the osmium mediators	118
Figure V.2. Cyclic voltammetry for the Ose mediator at 2mV s^{-1} in $400\mu\text{L}$ of a 0.05M tris-HCl buffer solution, 0.2M NaCl, pH 7.0, Ar-saturated, containing 0.25M glucose, at 25°C	121

Figure V.3. Variation of the electron transfer rate constant (k_{ET}) with the mediator global charge	123
Figure V.4. Variation of the normalised electron transfer rate constant (k_{ET}) and specific activity with the pH for the Osa and Ose mediators and O ₂	125
Figure V.5. Variation of the electron transfer rate constant (k_{ET}) with the mediator redox potential (E_{redox} vs. Ag/AgCl)	127
Figure V.6. Variation of the logarithm of the electron transfer rate constant (k_{ET}) with the difference in redox potentials between mediator and GOx active centre (ΔE_{redox} vs. Ag/AgCl)	128
Figure V.7. Variation of the normalised electron transfer rate constant (k_{ET}) with the ionic strength (I) for the Os0, Os2 and Os3 mediators	129
Figure V.8. Variation of the normalised electron transfer rate constant (k_{ET}) with the ionic strength (I) for the Osa, Osb and Ose mediators	130
Figure V.9. Variation of the logarithm of the electron transfer rate constant (k_{ET}) with the ionic strength function (f(I)) for the Osb mediator	132
Figure V.10. Variation of the logarithm of the electron transfer rate constant (k_{ET}) with the ionic strength function (f(I)) for the Ose mediator	133