Research Project
The present research program is developed within the MolArNet Project, supported by the European Commission within the FP7-ICT-2011-8 call (http://www.molarnet.eu/). MolArNet, that is Molecular Architectures for QCA-inspired Boolean Networks, aims at demonstrating a feasible molecular scale architecture for post-Moore nano-electronics as a possible route towards unconventional models of computation. The final goal is a first demonstration of feasibility for molecular Quantum Cellular Automata (QCA) elementary devices, working on both technological and design levels. In QCA no switches (transistors) and hence no current flow are required. Computation is still binary and Boolean, but the bit is represented through the charge configuration in a basic cell, which, in the classical case, is an arrangement of four quantum dots, joined by tunnelling paths and charged with two mobile, opposite-spin electrons and a compensating fixed positive charge.

In the MolArNet project, the QCA units are molecules. Chemists play, therefore, a unique role in the project designing, synthesizing and characterizing the species that in the final device will have to perform the computing operations.

Important steps in the MolArNet project are:
(i) tailored design of molecular systems suitable for QCA applications, their electrochemical characterization and their molecular assembly in ordered molecular arrays;
(ii) advanced characterization by state of the art scanning tunneling microscopy and development of single molecule addressing protocols for manipulation, interconnection and read/write steps;
(iii) theoretical simulations at both the molecular and architectural levels.

The research activity carried out in the Laboratory of Electrochemistry of Molecular and Functional Materials (EMFM) of the Department of Chemistry "Giacomo Ciamician" of the University of Bologna, will focus on the investigation of the redox properties of molecular candidates for the QCA that are synthesized in the Organic Synthetic Groups of the Department involved in the same project. The work will be carried out using state of the art electrochemical techniques available at the EMFM (including SECM and EIS) and taking advantage of the equipment and procedures therein developed which allow to perform experiments on highly reactive species under carefully controlled conditions.

The candidate should possess a strong theoretical knowledge of molecular and supramolecular electrochemistry and a strong competence in the use of electrochemical techniques applied to such systems.

The activity will be carried out in strict collaboration with the other research Groups involved in the MolArNet project. The candidate is expected to have a good knowledge of English and to take part in the periodic Meetings organized by the members of the network.

Activity Plan
The activity includes the investigation of the redox properties of the QCA unit in solution aimed at the determination of the relevant thermodynamic parameters and the investigation of the stability of the species in its various redox states (months 1-5).
In the following step (months 6-12), the units will be immobilized onto suitable surfaces and their redox behaviour will be investigated both by bulk techniques (such as CV and EIS) and by scanning probe techniques (SECM).