Under suitable conditions anodic metal oxidation leads to growth of complex porous structures. The initiation and growth of these structures is an interesting and challenging task for electrochemical modelling. One must identify chemical reactions in a multi-phase framework, derive a proper partial differential equations and solve them in time dependent domains. In this work, electrochemical model for the oxide growth in nano scales is presented. Physically motivated equations are formulated with precise mathematical meaning and existence of solutions is studied. Electrostatic potential fulfilling high-field conduction law and interfacial jump conditions is sought for. Numerical discretization is performed with the use of finite element method and free boundaries are tracked with characteristic level-set functions. Basic mechanism governing the growth of porous structures is given and numerical experiments are explained on it's basis. This thesis presents novel contributions to the electrochemical and mathematical picture of nanopores growth.