This thesis studies preparation of nanostructured Pt(111) surfaces for usage in model electrocatalytic experiments. A method is presented, that uses ion erosion of the surface at elevated temperature for surface preparation. The results of the thesis suggest, that comparing to other methods of nanostructured surface preparation in present electrochemical practice the ion erosion is an effective and practical tool for preparation of surfaces with morphology controlled at the atomic level and that it has a potential to accelerate the development of knowledge in this area.