The presented thesis deals with the study of the sheath layer which is formed during the interaction of a low-temperature plasma with a solid object using computer modelling techniques. The theoretical part of the thesis summarizes knowledge about the physics of the sheath layer of electropositive and electronegative plasma and presents the theory of measuring plasma parameters using a Langmuir probe, including a discussion of the effect of collisions of charged particles with neutrals on the probe measurements. Further, theoretical descriptions of the plasma are presented which are the basis of the computer models created in the framework of the thesis: a particle model based on the Particle-in-Cell method and a fluid model of the drift-diffusion approximation of the plasma. The developed particle model works in 3D space, uses the null-collision Monte Carlo method to account for the effects of collisions of charged particles with neutrals and implements the Intel Math Kernel Library functions to solve the Poisson's equation. The fluid model is implemented using FeniCS software. At first, the developed models are used for the calculation of the sheath layer and the current-voltage characteristics of free-standing Langmuir probes of several types: a 1D model of an infinitely large planar probe, a 2D model of a cylindrical probe and a 3D model of a planar probe of finite dimensions. Calculations are successfully compared with theory and mutual differences when using different modelling techniques are discussed. Attention is also paid to the interaction of the sheath layers of two Langmuir probes at a close distance to each other. It is observed that the interaction can occur over a long distance thanks to the long-range electric field in the pre-sheath. With the selected pressure regime, a decreasing profile of the number density of charged particles is observed towards the surface of the probe according to the solution of the diffusion equation -- if the probe comes close to another one that measures the current-voltage characteristic, its presence leads to a decrease in the measured current and an underestimation of the evaluated plasma density. If a probe with a constant bias voltage is placed near the probe measuring the current-voltage characteristic, the measured electron temperature is also distorted; if the interacting probe is held at a floating potential, then the influence of its presence on the measured value of the electron temperature is not observed.