In the presented thesis, new optical biosensor platform for high-throughput label-free monitoring of biomolecular interactions is reported. This biosensor platform is based on a spectroscopy of surface plasmons on an array of miniature diffraction gratings. Each miniature grating serves as an independent sensing channel and allows for monitoring of optical density changes induced by biomolecular interactions on the grating surface. The presented platform has a potential for monitoring of hundreds of interactions on a single sensor chip. The presented research include theoretical study of surface plasmon resonance on metallic diffraction gratings and the analysis of diffraction grating-based SPR biosensor. In the experimental work, preparation, replication and characterization of diffraction gratings is carried out. A prototype SPR sensor device including an SPR sensor chip with a twodimensional array of sensing channels, fluidic system and SPR chip reader is developed and its main performance characteristics are determined.