The present research work contains a study concerning polymer micro components manufacturing by means of the micro injection moulding (µIM) process. The overall process chain was considered and investigated during the project, including part design and simulation, tooling, process analysis, part optimization, quality control, multi-material solutions. A series of experimental investigations were carried out on the influence of the main µIM process factors on the polymer melt flow within micro cavities. These investigations were conducted on a conventional injection moulding machine adapted to the production of micro polymer components, as well as on a micro injection moulding machine. A new approach based on coordinate optical measurement of flow markers was developed during the project for the characterization of the melt flow. In-line pressure measurements were also performed to characterize the process in terms of injection time depending on the process factors. The process quality in terms of repeatability was assessed over a broad range of the process factors. The results show that the main influencing factor on the micro injection process is the injection speed. Defects of injection moulded parts as weld lines were investigated on polymer micro parts. Design of experiments and atomic force microscopy were employed to characterize depth and width of weld lines depending on µIM process factors. Experiments showed that the temperature of the mould, the injection speed and the weld lines position with respect to gate location were the most important parameters on the weld lines of the micro injection moulded part. Optimization following the analysis lead to a decrease of weld lines depth and width of at least 35%. A round robin among European partners of the Network of Excellence 4M (Multi-Material Micro Manufacturing) was performed in order to assess the performance of newly developed hybrid technology for micro tooling. A new manufacturing route was established including µEDM of silicon, selective etching and electroforming. The tool produced using the new process chain showed significant advancements in terms of miniaturization, accuracy, high aspect ratio, multi-scale integration and surface finishing characteristics. The tool was tested on an injection moulding machine for the production of polymer micro fluidics systems. New methods for the validation of commercially available injection moulding simulation software were developed and implemented during the project. Software predictions in terms of injection time, injection pressure and flow pattern of micro injection moulded parts were improved by using advanced optimization strategies. The importance of material characterization at micro scale, of machine’s dynamic behaviour implementation and of micro geometry modelling was shown in a quantitative study. Insert moulding and hot embossing processes were investigated for the manufacturing of multi-material miniaturized components. A mould was developed and validated for the production of hybrid polymer/metal miniaturized parts by over moulding. Micro metal inserts with thickness down to 20 µm were moulded in a polymer matrix. The influence of metal surface treatment, insert thicknesses, different material combinations and different processes on the bonding strength between polymer matrix and metal part was determined.