Since Bio-optoelectronic detection is very highly precise, therefore, its application in the bio technology has drawn more and more attention nowadays, more and more countries get aggressively involved in the research of bio-optoelectronics. Currently, micro optoelectronic detection system has been used in the biochip field.

Under the influence of miniaturization, smart and low cost trend of biomedical detection system, MEMS system process technology has now been widely used in the manufacturing of biomedical detection chip, this includes chip type electrophoresis system. Currently, some simple and easy researches on biomedical separation chip are published and turned into products one after another, since the research resources are so abundant in recent years and in many countries, multiple function integrated type micro chip system is going to be the mainstream in the biomedical detection market.

This study uses a self-installed optical system to detect the concentration of fluorescent dye, meanwhile, biological sample separation detection can be done through fluorescence combination technology, we try to develop a bio-optoelectronic system which uses only small amount of sample and has fast detection result. Besides, considering the characteristic of the biological sample, an optimum system architecture is designed together with micro channel technology to form a micro electrophoresis chip detection system.

This thesis aims at preparing micro electrophoresis chip, polymer material is used as the base to replace traditional capillary electrophoresis and separation device, the major purpose is to miniaturize the system, reduce the cost and analysis time. In this study, MEMS technology and substrate bonding technology are used to prepare micro chip type electrophoresis system.

Fluorescence detection uses the characteristic that fluorescent dye has special excitation and emission wavelength and it can be used to mark on the object to be tested. Fluorescent probe let us be able to know how complicated biological molecule comprises special composition, this includes the live cell, etc. In the followings, we are going to briefly describe the fluorescent technology.

Fluorescent phenomenon: When photons are of enough energy, they will excite the electrons in the material into excited state, normally, electrons will go back to base state immediately and emit the light. When the electrons in the fluorescent material are excited to the excited state, they will be limited at that state or will go back to base state for a longer time through different path. In fluorescent detection, zero to certain number of photons can be generated though optical illumination, the photons

are then detected at detector. A certain number of photons can generate certain electric current.

In the fluorescent optoelectronic detection system and in the sample analysis process, excitation light of specific wavelength has to be selected in order to generate special fluorescent light, fluorescent spectroscopy is now frequently used in the biological detection.

DNA electrophoresis is frequently used to analyze the molecular size of DNA, to perform quantitative analysis or purify the DNA molecule. Capillary Gel Electrophoresis technology was developed in 1987, a polymer of certain elastomeric property is filled in the capillary, it forms an entangled state. The interstice among entangled molecules is small and of irregular shape.

Capillary gel electrophoresis, among the current available analysis technologies, is the one with very high separation efficiency, its theoretical board number can reach several millions in each meter. Gel is like jelly, it forms net-like structure after it condenses and has the function of molecular sieve, it can be used as the separation medium in electrophoresis, besides, gel is non-conductive type medium, it can reduce the zone broadening phenomenon due to solute diffusion, it can also prohibit electroosmotic flow and reduce the adsorption of solute on the capillary wall.

The major separation mechanism is, gel will form voids of specific sizes, when the materials to be analyzed pass through the gel medium, they will be blocked in different levels due to the sizes of the materials to be analyzed, therefore, they will have different migration speed, and the separation function can then be reached [55-56].

Traditional electrophoresis uses flat gel electrophoresis slot as shown in figure 5-1, a box of multiple channels are injected with gels, through the electricity-carrying characteristics of DNA molecules and through gel electrophoresis method, we put DNA molecules in the gel and apply electric field to them, they will move at different speed due to their different molecular weight, therefore, the molecular size of DNA can thus be judged, the result is as shown in figure 5-2(a). Figure 5-2(b) shows the data of Lambda DNA [57].

After the samples have been prepared, we inject the gel first, we then inject 1×TBE(Tris borate EDTA)buffer solution into the micro channels, the reason we use TBE buffer solution is to distribute the electric field in the gel, then sample and fluorescent dye are fully mixed and sent through the sample injection hole.

Capillary electrophoresis needs only small amount of sample for analysis, we design the micro channel into I shape, then through gel electrophoresis method, DNA molecules are placed in the gel,

since the DNA molecule has electricity-carrying characteristic, we apply an electric field of 50V/cm, since the difference in the molecular weight will affect their migration speed, the detection is then performed through an optical sensor with the help of an amplifier, the molecular size of DNA can then be judged.

The separation efficiency of micro electrophoresis chip is directly related to the strength of the separation electric field. In this study, the electric field strength is fixed at 300V/cm. As shown in figure 5-5, applied voltage is used to control the fluid sample injection method, in operation, it can be divided into injection mode (Power A on, B off) and separation mode (Power A off, B on), the SEM of cross separation micro channels is as shown in figure 5-6, the self-made optical sensor devices are as shown in figure 5-7 and figure 5-8, meanwhile, amplifier is used to amplify the signal and a simple sensor detection system is thus made. The experimental results are going to be discussed in 5-6.

In the quantitative design of the samples to be analyzed, we need only to change the width and depth to control the sample injected volume. If the injected sample quantity needs to be increased, double T shape micro channels can be designed in the future.

We use p-n optical sensor and MSM optical sensor for fluorescent concentration detection, this experiment can successfully detect sample's fluorescent response, MSMPD can have better detection sensitivity.

Finally, after the experiments, we compare the results with traditional flat electrophoresis results. We find that capillary gel electrophoresis takes only small amount of sample for analysis.

However, there is noise interference in the measurement process, in the future, anti-noise design can be reinforced. Besides, we use gel electrophoresis, we change the temperature to verify the effect of temperature on the electrophoresis, as shown in figure 5-13, the higher the temperature, the higher possibility DNA gets damaged, and the noise band thus increases, therefore, the separation efficiency will be reduced, we suggest it is operated under 50℃.

Besides, in the micro channel system, different fluids can be mixed together by using turbulence and the internal diffusion effect, the mixer designed has very high mixing efficiency, accompanied with

electrophoresis technology, they are going to be very attractive in the DNA analysis field. Fluid mixer is still in the test stage, there is still room for development in the future.