CONCLUSIONS

The attention of this thesis has been focused on the realization of a holographic diffraction gratings in composite materials. The starting point is a general description of the diffraction light in periodic structures. In particular in the first chapter we clarify the terminology of "*thin*" and "*thick*" gratings. By using two governing parameters, namely thickness and fringe spacing, it is possible to obtain a physical interpretations of the two regimes depicted by these two terms. From an experimental point of view, we starte with a comparison between diffraction structures in Polymer Dispersed Liquid Crystals (PDLC) and POLICRYPS realized in the same conditions. The main results show that POLICRYPS gratings represent an excellent improvement both in the morphology and in the electro-optical response. The stability of the experimental setup is a key element when considering realization of holographic diffraction gratings by UV curing techniques. In the second chapter we report the features of a novel technique which allows an *in situ* control and stabilization of an interferometric setup. We have exploited this technique to stabilize the process of fabrication of POLICRYPS diffraction gratings. By using a piezo-mirror in feedback configuration it is possible to obtain an excellent degree of stability (either with or without the help of anisolating box) limited only by the accuracy of the used piezo-system.

Optical tuneable filters are essential components in the next generation Fiber-To-The-Home, wavelength division multiplexing, optical communication systems and in optical sensor systems. Such devices continue to stimulate an extensive research activity. In the third chapter we introduce a new compact and low cost tuneable and switchable guided wave optical filter using a holographic Bragg grating as the optic field perturbation element. The filter has been obtained by using the POLICRYPS as overlayer of a double ion-exchanged glass, single mode channel, optical waveguide.

The filter structure includes coplanar electrodes which allow in plane reorientation of the liquid crystal (LC) molecules between the polymeric slices of the POLICRYPS. By applying a suitable control voltage, the desired tilt of the LC molecules and the corresponding required profile of the refractive index is obtained. In this way the Bragg wavelength is controlled by changing the effective refractive index of the guided mode. The output results with a 20 dB suppressed signal at the designed Bragg wavelength. A tuning range of ≅ 4 nm is obtained by applying a square wave of about 40V of amplitude. The device is the demostration of a simple and inexpensive technology that enables fabrication of optic functional components integrated on glass.

The last part of the thesis deals with utilization of diffraction grating in LC composite materials for display applications. Standard LCD are not very efficient and diffractive colour separation is an innovative technique useful to obtain an efficient LCD system; In particular colour separation can be realize by using a periodic structure on top of a light guide . In the last chapter the attention is focused on the realization of such a periodic structure using holography. By utilizing a stable and homogenous interference pattern, it has been possible to realize a periodic structure with good optical properties on a photosensitive material. The realized structures present good and uniform diffraction efficiency. In order to realize large area grating a nice and innovative technique has been implemented; we propose to call it “*Step and repeat process*”. The colour separation backlight is the heart of this work. By using an autronic-Melchers it is possible to realize an angular scan of the outcoupled intensity. The three main CCFL lines due to red, green and blue phosphors are coupled out in slightly overlapping angular regions between -30^{o} and $+30^{o}$. This system will be utilize in the next future in order to realize efficient LCD.