Chapter 6

General conclusion and future prospects

General conclusions and future prospects are discussed in this concluding chapter.
Conclusion and future prospects

Conclusion

Polymer optical fiber based systems are strongly being considered as a potential replacement for silica fiber based systems. This is due to the various advantages of polymer optical fiber over silica optical fiber such as low weight, low processing temperature, economical viability, ease of fabrication and so on. The five chapters of this thesis presented the fabrication and characterisation of polymer optical fibers in their applications as optical amplifier and smart sensors.

Optical polymers such as PMMA are found to be a very good host material due to their ability to incorporate very high concentration of optical gain media like fluorescent dyes and rare earth compounds. High power and high gain optical amplification in organic dye-doped polymer optical fibers is possible due to extremely large emission cross sections of dyes. Dye doped (Rhodamine 6G) optical fibers were fabricated by using indigenously developed polymer optical fiber drawing tower. Loss characterization of drawn dye doped fibers was carried out using side illumination technique. The advantage of the above technique is that it is a nondestructive method and can also be used for studying the uniformity in fiber diameter and doping. Sensitivity of the undoped polymer fibers to temperature and microbending were also studied in its application in smart sensors.

Optical amplification studies using the dye doped polymer optical fibers were carried out and found that an amplification of 18dB could be achieved using a very short fiber of length 10cm. Studies were carried out in fibers with different dye concentrations and diameter and it was observed that gain stability was achieved at relatively high dye concentrations irrespective of the fiber diameter.
Due to their large diameter, large numerical aperture, flexibility and geometrical versatility of polymer optical fibers it has a wide range of applications in the field of optical sensing. Just as in the case of conventional silica based fiber optic sensors, sensing techniques like evanescent wave, grating and other intensity modulation schemes can also be efficiently utilized in the case of POF based sensors. Since polymer optical fibers have very low Young’s modulus when compared to glass fibers, it can be utilized for sensing mechanical stress and strain efficiently in comparison with its counterpart. Fiber optic sensors have proved themselves as efficient and reliable devices to sense various parameters like aging, crack formation, weathering in civil structures. A similar type of study was carried out to find the setting characteristics of cement paste used for constructing civil structures. It was found that the measurements made by using fiber optic sensors are far more superior than that carried out by conventional methods. More over, POF based sensors were found to have more sensitivity as well.

**Future prospects**

Polymers like PMMA are good host material for various amplifying media such as organic laser dyes and rare earths. Since the doping concentration can be increased to a greater degree than in the case of inorganic glass, amplifiers using polymers as the host medium is short in length and thereby reducing the overall system size. Studies can be extended to different stable laser dyes and rare earth elements by doping these materials at very high concentration to the polymer matrix. This enables light amplification studies on all possible visible wavelengths and even communication wavelengths. Prospect of using dye mixtures in tunable fiber amplifiers is also very good. Polymer optical fiber lasers at both visible and IR communication regime can also be envisaged.
Conclusion and future prospects

Fiber nonlinearity is very high in POF when compared to glass fibers and the nonlinearity can be controlled by adding appropriate materials to the polymer. Nanoparticle can be doped in polymer fibers to tailor the nonlinear properties of the fiber for studies using ultra short pulses.

Both polymer fiber Bragg and long period gratings can be fabricated to realise more sensitive fiber optic sensors. Fiber optic active devices like optical diodes and computational elements can also be investigated.

Another interesting area which has a bright prospect is the fabrication of speciality fibers like microstructured and photonic band gap fibers. Its operations in the ultrashort regime are also worth investigating.