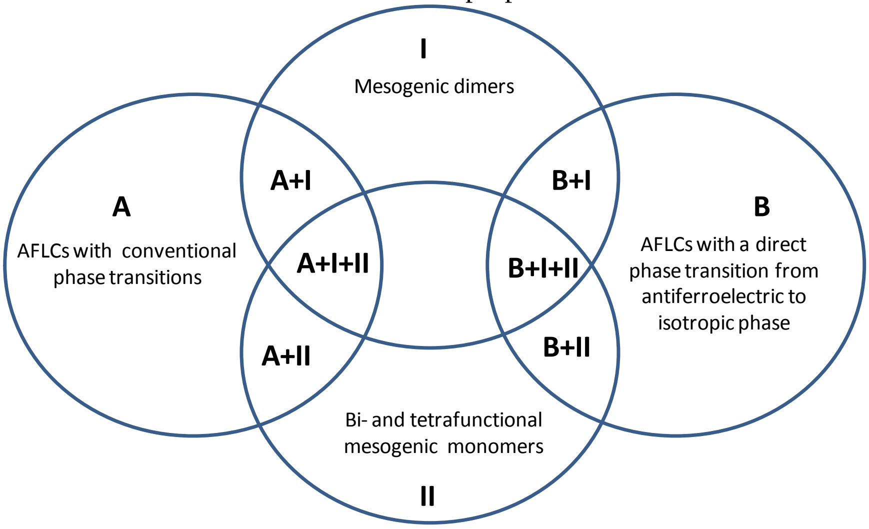
Nowadays liquid crystalline materials are used not only in displays but generally in optical modulators (phase and amplitude modulators). Such applications include, polarization control and intensity modulators for optical communication, tunable lenses for adaptive optics and for eye vision correction, spatial light modulation, tunable lasers and biosensors. The major reason for such a broad application potential of liquid crystals are their unique optical properties (transparency, homogeneity, birefringence, etc.). They can be easily included in microdevices and optical fibers, and are low cost components. Moreover, they can be mixed with other substances in order to obtain new composite materials having completely different and very interesting optical, electro-optical, thermal and mechanical properties. Finally, they are sensitive to external fields, including optical fields, so they can be used as active materials in optical and electro-optical devices. The main limitations of liquid crystals in their commonly use for optical modulators are their switching times and optical quality. At the most common used nematic liquid crystals, it seems impossible to make electrooptical devices having an overall switching times less than dozens microseconds. It should be stressed, however, that for a great number of practical applications electrooptical devices with time responses less than 1 ms are considered fast. In these cases, the use of liquid crystals faster than nematic one may present great advantages. Much faster switching (below 1ms) can be obtained in ferroelectric (FLCs) and antiferroelectric liquid crystals (AFLCs). Due to properties promising passive addressing capabilities the most perspective seems to be AFLC materials. However, still the main problems of AFLCs materials are asymmetrical switching times (fall time is much larger than rise time - $\tau_{off} >> \tau_{on}$) and asymmetrical electrooptical curve, observed for positive and negative electric field. Based on above, the main goal of this proposal is to develop antiferroelectric liquid crystalline materials which will be characterized by very short and symmetric switching times- $\tau_{off} = \tau_{on} < 200 \mu s$ and high optical quality in elecrooptical cell. General scheme of methods to obtain AFLC materials with above properties is shown below



Main research tasks, besides of synthetic ones, are connected with the formulation and full characterization of bi- and multicomponent mixtures based on AFLC materials **A** and **B** posses the best mesomorphic, physic and elelctrooptic properties with dimers **I** or/and monomers **II** (**A+I, B+I, A+II, B+II, A+I+II, B+I+II**). It will be check how molecules of dimer influence on smectic layers and change their relaxation properties as well as how polymer network influence on elastic and termodynamic properties of liquid crystalline materials. Besides approaches connect strictly with AFLC materials and their modification, it is planned to systematic investigation of different kind of electrooptical cells geometry and alignment layers on their switching times and optical properties, after fill by AFLC materials prepared under this project. The research methodology will be based on multi-step organic syntheses as well as mesomorphic, physical and electrooptical investigations in well equipped laboratories at Faculty of Advanced Technologies and Chemistry MUT.
Planned research under this project should give answers for many questions about nature of interactions between AFLCs and mesogenic dimers, polymer network as well as with surface of the cell. Moreover, developing under results of this research project antiferroelectric liquid crystalline materials, can open new possibilities to apply such materials in optical modulators with submilliseconds symmetric switching times and high optical properties and will be corresponding for expectations of many commercial companies (e.g. Forth Dimension Display or Smart Digital Optics Company), which produced electrooptical and photonic devices.