Two distinct branches of optics are combined in this work: Time-domain terahertz spectroscopy, and photonic structures. The work at rst provides a survey of tools utilized for exploration of the terahertz region, and it enriches them by a method for simultaneous determination of dielectric and magnetic response of materials and metamaterials. Photonic structures operating in the terahertz range form the subject of the rest of this thesis. A periodically modulated dielectric waveguide is studied theoretically using a modal method: The band structure of guided and leaky modes is calculated and resonant modes are described. One-dimensional photonic crystals with a defect are then investigated in detail. Formation of defect modes is analyzed theoretically in a photonic crystal with a twinning defect. The analysis makes it possible to formulate requirements on a design of a structure with defect modes tunable by external parameters. Following these guidelines, we have successfully designed, fabricated and characterized photonic crystals with thermally tunable defect modes with relative tunability reaching 60 %.