Title:	Quartz Crystal Microbalance Technique for Chemical and Biological Applications
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Abstract:	Sauerbrey discovery in 1959 [Sauerbrey 59] of relating mass variation due to frequency shift makes the necessary foundation of sensors based on the quartz in air and vacuum and then Nomura and Okuhara [Rodahl 96] also made it applicable in the liquid medium. All these discoveries attracted a lot of attention of the scientist working in various fields. So in the last 40 years, the quartz crystal(QC) has been of great importance due to its full appli cations in the electrochemistry, bio-sensors, gas sensors, probing bio-molecular interaction, and microorganism. Thus quartz crystal oscillators(QCOs) have proved themselves to be a unique laboratory for sensing. Moreover, recently the study of magnetic properties and noise measurement could also be possible with a quartz crystal oscillator. Ultimately we can say that QCOs become an indispensable tool for broad applications in physics, chemistry, and biology. The questions that are inquisitive for me that I tried to explore in the thesis are related to the physics of liquid crystal(LC) and the responsible parameters that significantly affect Q factor during its loading, probing bio-molecules with quartz and mass detection of chemicals. This thesis tries to provide a brief overview of the theory and applications of quartz crystal oscillators(QCOs). The piezoelectric nature of quartz, an amazing feature of quartz crystal, and due to its high stability over a wide range of temperatures, quartz crystals have a broad range of applications. The research work in this thesis is at the inter face of physics, chemistry, and biology. I focus on the applications of quartz, mainly in the fields chemistry utilizing techniques of microwave physics. I use quartz crystal microbal ance technique and developed a system for the mass detection and probing bio-molecular interaction, and Lock in amplifier, signal generator, LabVIEW for the study of physical properties of liquid crystals(LCs) 4-Cyano-4'-pentylbiphenyl(5CB). Moreover, in this thesis, some techniques involved fabrication and lithography are discussed in the appendix section. The mass sensing of Hexamethyldisilazane (HMDS), which turns out to be after calcula tion from the Sauerbrey equation, is 1.59×10ж8 grams. I studied the phase transition of 4-Cyano-4'-pentylbiphenyl liquid crystal at temperature 34.2oC, which is close to its tran sition temperature 35oC. The deviation from its exact transition temperature is due to not having good control over temperature. I also made Wilkinson power divider in EagleCAD software (used in designing PCB and electronic component) is also in the appendix.
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