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Modification of $LiNbO_3$ Properties with Tetravalent Dopants

Lithium Niobate, $LiNbO_3$ is used extensively in the telecoms market. Dopants, which are intentionally introduced during the growth process, can significantly modify properties of the crystals. My project will be to investigate structure defects in $LiNbO_3$ crystals doped with tetravalent impurities like zirconium, Zr and tin, Sn. Until now the $LiNbO_3$:Zr was rarely studied by the magnetic resonance and optical spectroscopy. Therefore, it is not known, what the charge state of Zr in $LiNbO_3$ crystals is, what ion (Li or Nb) it substitutes, and what the mechanism of the excess charge compensation is. I shall learn technique of magnetic resonance and optical spectroscopy, measure and compare spectra of the Electron Paramagnetic Resonance and optical absorption of nominally pure and doped crystals. So far, I have learned how to effectively operate the EPR machinery and collect measurements from samples. In addition to learning how to logically operate the machine parameters, I have taken in much of the theory behind the process. I plan on conducting more angular dependence studies of Lithium Niobate crystals. I will take measurements at both room temperatures and at low temperatures, achieved with liquid helium, in order to search for rare earth ion dopants., specifically holmium, chromium, and manganese. Low temperature measurements are useful because many rare earth elements commonly appearing as dopants in the crystal only respond to the electron paramagnetic resonance at low temperatures. I will be conducting angular dependence to find the signals at the position perpendicular to the x, y, and z planes in order to learn about the crystal structure and locations of the dopants. All of this information will help to better understand the optical and acoustical characteristics resulting from dopants in the Lithium Niobate crystal. I plan on presenting a poster at the research celebration in April on my findings and analysis. The work will be carried out in the Magnetic Resonance Laboratory (Physics Department, MSU) under supervising Prof. G. Malovichko.