Synthesis of Single-Crystalline Lithium Tantalate Nanorods – Piezoelectric and Non-Linear Optic Properties

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One-dimensional nanostructures provide an exceptional platform to realize nanoscale electronic, optical and mechanical devices. $LiTaO_3$ and $LiNbO_3$ are two of the most widely used multi-functional perovskite oxides, out of which nanorods and nanowires of $LiNbO_3$ have found tremendous applications in several devices in the piezoelectric and non-linear optical regime. But synthesis and properties of $LiTaO_3$ nanorods are hardly reported, to the best of our knowledge. In this work, we successfully synthesized single-crystalline $LiTaO_3$ nanorods (an average length of 3 μm and breadth of 300 nm) by a facile, yet rapid molten-salt reaction technique (the reaction was completed within 15 min). X-ray diffraction and Raman studies confirm the formation of $LiTaO_3$ phase, along with a minor impurity phase. The single crystallinity of the nanorods was confirmed from the selected area electron diffraction pattern obtained from individual nanorods. Piezoelectric properties of individual nanorods were studied using Piezo-Force Microscopy and a piezoelectric coefficient of 8 pm/V was obtained. The second harmonic emission at 532 nm was recorded as a function of incident intensity (at 1064 nm) in a reflection mode. A much improved second harmonic intensity emanated from the nanorods as compared to cubic crystallites of $LiTaO_3$. $LiTaO_3$ nanorods can be an excellent candidate for nanoscale devices due to its multi-functionality, since $LiTaO_3$ has a high pyroelectric coefficient, remanant polarization and non-linear optical coefficient.