Harmonic and Subharmonic Generation Analysis on ADP and Rochelle Salt Piezoelectric Crystals

A. Garcia-Quiroz[C, S]
Departamento de Física, CINVESTAV-IPN, México D.F., Col. San Pedro Zacatenco, México
alberto@fis.cinvestav.mx

C.A. Alves, J.C. Costa, S.G.C. Moreira, and D. P. Pereira
Departamento de Física, Universidade Federal do Pará, Campus do Guamá, Belém, Pará, Brazil

Nowadays, many theoretical models, which use different experimental techniques to investigate frequency generations, exist. These approaches have been developed in different physical fields, such as optics, magnetism, and mechanics, etc. The search for and improvement upon mathematical models and experimental methods which use crystalline materials to better understand piezoelectric material properties have interested some physicists.

We used a three-electrode system to analyze harmonic and subharmonic frequency generations in two different piezoelectric materials: ADP and Rochelle salt crystals. The generated frequencies were discriminated from piezoelectric resonance production when some low excitation frequencies were applied.

The ADP ($NH_4H_2PO_4$) piezoelectric crystal has a tetragonal structure, which belongs to 2m-space group. At room temperature, 295 K, it is in the paraelectric phase, and below Curie temperature, T_c = 148 K, it is in the antiferroelectric phase [1-3]. The Rochelle salt ($NaKC_4H_4O_6{\cdot}4H_2O$) piezoelectric crystal (RS) is in the ferroelectric phase between 255 and 297 K and is in the paraelectric phase below 255 K and above 297 K [4-7]. These properties cause the crystals to be both scientifically and technologically overwhelming.

Harmonic generations have been studied in accordance with an effective RLC circuit model, where the dielectric material was just crystal sample, and the mathematical approach used was based on Duffing´s equation. Furthermore, applying the three-electrode system permitted good piezoelectric resonance discrimination and, therefore, an accurate measurement analysis. The new experimental configuration was a quite simple and efficient method for studying harmonic and subharmonic frequency generations.