Life Time of Phonon Hole

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Hole burning phenomena have been studied in the field of light absorption. The required condition for hole burning observation are

1: Collected absorbers, whose absorption frequencies are slightly different from each other, have a moderately and wide spread absorption spectrum as a whole.

2: Absorbers can change their absorption characteristics by large amplitude light. A hole in the absorption spectrum can be introduced by absorbing large amplitude light with a certain frequency.

These are satisfied by other system than optical absorption. We applied this notion to piezoelectric particles which resonantly absorb oscillating electric field. Piezoelectric particles with different figure and dimensions show a moderately and widespread absorption spectrum. When large amplitude electric field with certain frequency are applied to particles, some change is brought into the oscillating characteristics and their absorption spectrum as a hole, which we call a phonon hole.

We have detected phonon holes in some kinds of piezoelectric particles and have analyzed the mechanism. This time, we studied about the lifetime of the phonon holes.

The specimen were prepared from commercial grade $KBrO_3$ particles with its diameter between 105 and 125 um. Particles of the order of 10^6 were packed in a parallel plate condenser, and pulsed rf electric field with amplitude of 200 V/mm, pulse width of 100 us and total pulse number ranging to several hundreds were applied. Holes were detected in the complex electric impedance of the condenser filled with the particles. We measured the time dependence of hole height in the real part of the impedance.

When holes written with low amplitude field or small number of pulses, the hole height gradually decreased and became undetectable after several days. In the case of the holes with large amplitude and large number of pulses, the hole height decreased gradually, but were detectable after several months.

These experimental data were explained that the holes were constructed with the plastic deformation or the introduced crystal dislocations. Crystal dislocations contribute to some part of the elastic constant of a particle and damping constant of particle oscillation. These changes appeared as the measured electric impedance and a hole. The dislocations could disappear through meeting ones with different sign or motion out of particles. The tangles dislocations introduced with large amplitude pulses could not easily disappear and contributed permanent holes.