DEBYE TYPE SAW ATTENUATION IN C_{60} THIN FILMS BELOW GLASS TRANSITION TEMPERATURE

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C_{60} crystal is an attractive material because of its higher molecular symmetry and peculiar crystal properties. This material shows interesting behaviors in temperatures less than 100K, for instance, the glass transition of the direction of the molecular rotation at about 100K, the freezing of the molecular rotation at about 50K, the superconductive transition at about 20K in alkali metal doped solid C_{60}, etc. Therefore, it was expected to investigate the dynamics of molecular solid of C_{60} at low temperatures. The ultrasonic attenuation method was available to investigate the solid dynamics, so that the ultrasonic attenuation measurements in C_{60} thin films were carried out by using the SAW devices.

C_{60} thin film was deposited by the vacuum evaporation method onto the surface of a SAW device. The SAW device consisted of a quartz substrate, and its fundamental frequency was 80MHz. C_{60} powder in the evaporation source had a 99.9%-purity. During the evaporation, the temperature of the evaporation source was kept at 575K and the temperature of the SAW device was kept at 475K. The thicknesses of C_{60} films were about 1500Å, and the typical area of films was 10×10 mm^2. The acoustic attenuation for C_{60} thin films were measured at temperatures between 15K and 65K, and the SAW frequencies were 320MHz, 400MHz and 480MHz.

The obtained curves had a attenuation peak arround 40K. This peak temperature was shifted to higher temperature with increasing frequency, and the magnitude of attenuation were larger with increasing frequency, also. Because of the features of these curves, it was expected existence of the Debye type relaxation mechanism. Therefore, the activation energy $E_a = 12.4$ meV and the relaxation time $\tau_0 = 9.35 \times 10^{-12}$ sec were estimated by Arrhenius plotting.

It is expected following description. This relaxation is originated from small orientational jump over local potential barrier of 12.4 meV in the orientaional potential arround pentagonal orientation.