Acoustic properties of Polydimethylsiloxane as a Function of Pressure

Sunhyeop Shin[1], Jae-Hyeon Ko[1,]*, Jaehoon Park[2], Young Ho Ko[3], and Kwang Joo Kim[3]
[1]Dept. of Physics, Hallym University, Chuncheon, Gangwondo 200-702, Korea
Tel.:82-33-248-2056, E-mail: hwangko@hallym.ac.kr
[2]Dept. of Electronic Engineering, Hallym University, Chuncheon, Gangwondo 200-702
[3]4-2-2, Agency for Defense Development, P.O. Box 35, Yuseong, Daejeon, 305-600

Polydimethylsiloxane (PDMS, $CH_3(C_2H_6OSi)_nCH_3$) elastomer is a widely-used Si-based polymeric material [1]. Determination of basic material properties of PDMS are very important for its application. The present study is to report the pressure dependence of elastic properties of PDMS over a wide pressure range from ambient pressure to ~8.5 GPa. The Brillouin light scattering combined with the diamond anvil cell technique was used for this purpose [2, 3]. The scattered light from PDMS includes the weak inelastic signal caused by the interaction between the incident photons and acoustic phonons. The sound velocity and the attenuation coefficient can be derived from the Brillouion frequency shift and its half width, respectively.

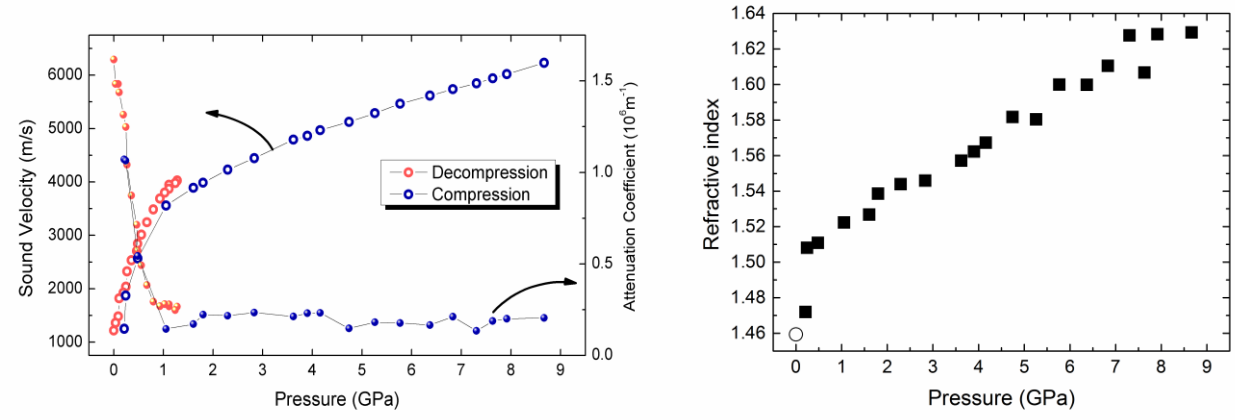

Fig. 1. The pressure dependence of the sound velocity/attenuation coefficient (left) and the refractive index (right) of PDMS.

Fig. 1 shows the pressure dependence of the sound velocity, the attenuation coefficient, and the refractive index of PDMS. The sound velocity increases rapidly upon compression from the ambient pressure to ~1 GPa, which is accompanied by substantial decrease of the attenuation coefficient. The change in the sound velocity at high pressures over 1 GPa is very mild and the attenjuation coefficient is nearly the same. A similar behavior can be seen from the pressure dependence of the refractive index. This crossover behavior at ~1 GPa may be attributed to the complete collapse of available free volume in PDMS and the resulting change in the density.

Acknowledgment

This work was supported by the Defense Research Laboratory Program of the Defense Acquisition Program Administration and the Agency for Defense Development of Republic of Korea and by the Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education, Science and Technology (2013R1A1A2006582).

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