

Non-destructive evaluation of polymer pipe degradation using terahertz inspection techniques

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Abstract: In this study, terahertz time-domain spectroscopy (THz-TDS) was used to inspect the degradation of polymer pipes in semiconductor manufacturing processes under cyclic stress condition. The defective specimens were prepared by fatigue testing within the elastic deformation range using perfluoroalkoxy alkane (PFA) pipes. The degradation of polymer pipes was analyzed by refractive index using time delay between the normal and defective pulse signals measured by THz transmission mode. As a result, the refractive index of the polymer pipe specimen decreased with an increasing number of cycles due to the decrease in the cross-linking of polymer molecules. In addition, the similarity between the refractive index and the number of cycles was confirmed as 97.6%. The developed THz inspection technique is expected to improve process yield by detecting degradation of the polymer pipes before failure through real-time, non-contact and non-destructive inspection method. **Acknowledgements:** This work was supported by Korea Institute of Energy Technology Evaluation and Planning(KETEP) grant funded by the Korea government(MOTIE)(20212020800090, Development and Demonstration of Energy-Efficiency Enhanced Technology for Temperature-Controlled Transportation and Logistics Center). This work was also supported by the Agency For Defense Development by the Korean Government(UD230502DD). This research was also supported by a National Research Foundation of Korea (NRF) grant funded by the Korean Government (MEST) (2021M2E6A1084690). This work was also supported by the National Research Foundation of Korea(NRF) grant funded by the Korea government(MSIT) (No. RS-2023-00260527).