

Abstract Submitted
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Effects of impurities on negative ion mobility in O₂ YUI OKUYAMA, SUSUMU SUZUKI, HARUO ITOH, Chiba Institute of Technology — We have investigated the effects of impurities on the negative ion mobility in O₂ at atmospheric pressure using a high-pressure ion drift tube with a positive point plate gap that acts as a negative ion detector. We reported a reduced mobility, in particular “zero field mobility” of 2.31 cm²/V·s for O₂⁻ in O₂.¹ This value is in good agreement with values in other reports of 1.95 to 2.42 cm²/V·s. Although many studies have been carried on the measurement of negative ion mobility over the last 50 years, discrepancies between the values obtained remain and the origin of the discrepancies has not been clarified until now. We found that one of the reasons for the discrepancies originates from impurities in O₂ that are considered to be released from the surface of the chamber as an absorbed gas (N₂ or CO₂) or to already exist in the O₂. These impurities form negative ions such as CO₃⁻, CO₄⁻, NO₃⁻ and N₂O₂⁻ with the O₂ in the chamber. The mobilities of these ions are slightly larger than that of O₂⁻. Therefore, if small amounts of impurities such as N₂ and CO₂ exist in O₂, an increased negative ion mobility is observed at $E/N > 2.54 \times 10^{-1}$ Td. Moreover, the negative ion mobility of O₂⁻ was also measured in high-purity O₂(99.9999%) and ultrahigh-purity O₂(99.99995%) while employing a gas filter that can reduce the water content to less than 100 ppt. As a result, the mobility of O₂⁻ was increased to 2.39 cm²/V·s. This value is close to the values reported by Dutton and Howells (J. Phys. B, 1, 1160, '68), Rees (Aust. J. Phys., 18, 41, '65) and Voshall et al. (J. Chem. Phys., 43, 1190, '65).

¹Y. Okuyama et al.: J. Phys. D: Appl. Phys., 45, 195202 (2012).

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