A $^{119}$Sn-Mössbauer study of tetramethylstannane isolated in low temperature argon matrix

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Unusually broad $^{119}$Sn-Mössbauer absorption was observed in pure Sn(CH$_3$)$_4$ or Sn(CH$_3$)$_4$/argon condensed at low temperatures by pulsed deposition. Such broadening of the Mössbauer linewidth suggested the presence of large quadrupole splitting due to possible distortion of molecular structure as deposited in the argon matrix.

INTRODUCTION

Matrix isolation is a useful technique for studying synthesis and/or chemical reactions of unstable compounds at low temperatures. We built a system for Mössbauer measurements of matrix-isolated species and investigated photoaggregation and photochemical reactions of iron complexes and organoiron compounds$^{1,2}$. However, no Mössbauer studies of matrix-isolated organotin compounds have
been conducted to date: only a few works have been report-
ed on matrix-isolated tin atoms and inorganic tin com-
ounds, while Mössbauer spectra of numerous solid or-
ganotin compounds have provided useful information re-
arding their electronic states and structures.

Accordingly, we have initiated Mössbauer measurements
of matrix-isolated organotin/IV/ compounds. The present
article reports the states of matrix-isolated tetramethyl-
stannane, Sn(CH₃)₄, studied by means of ¹¹⁹Sn-Mössbauer

technique, IR spectroscopy, and UV spectroscopy.

EXPERIMENTAL

A cryostat was specially designed for measurements of
Mössbauer, IR-, and UV-absorption spectra of matrix-
isolated species. A mercury-free glass vacuum line with
greaseless stopcocks was built for introduction of precisely
controlled amounts of sample gases into the cryostat.

Commercially available Sn(CH₃)₄ and argon were used after
purification. Tetramethylstannane was mixed with argon
before use: the mixing ratio (matrix/reactant, hereafter
denoted M/R) was 0 /no matrix gas mixed/, 100, 1000, or
10000. For matrix formation, the gaseous mixture was intro-
duced in pulses and deposited on Al, CsI, or sprasil
quartz plate /substrate/ which was cooled to 18 K by a
closed cycle helium refrigerator /Cryomini-D, Osaka Sanso
Co. Ltd./. In such pulsed deposition runs, the amount of
the gas per pulse introduced for deposition was carefully
controlled. For the purpose of comparing condensation
with solidification, a solid sample was prepared by cool-
ing liquid Sn(CH₃)₄ quickly down to 78 K.

Mössbauer spectra, IR spectra and UV spectra were
measured at 18 K, using an Elscint MDF-N-5 spectrometer