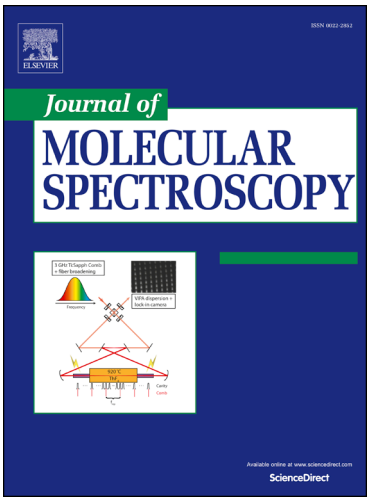

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PII: S0022-2852(17)30145-5
DOI: http://dx.doi.org/10.1016/j.jms.2017.06.004
Reference: YJMSP 10912

To appear in: *Journal of Molecular Spectroscopy*

Received Date: 20 March 2017
Revised Date: 18 May 2017
Accepted Date: 6 June 2017

Please cite this article as: K.L. Bris, J. DeZeeuw, P.J. Godin, K. Strong, Infrared absorption cross-sections, radiative efficiency and global warming potential of HFC-43-10mee, *Journal of Molecular Spectroscopy* (2017), doi: http://dx.doi.org/10.1016/j.jms.2017.06.004

Infrared absorption cross-sections, radiative efficiency and global warming potential of HFC-43-10mee

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Abstract

HFC-43-10mee ($C_5H_2F_{10}$) is a substitute for CFC-113, HCFC-141b and methyl chloroform, as well as an alternative to perfluorocarbons with high radiative efficiencies. Recent observations have shown that the global mean tropospheric abundance of HFC-43-10mee has increased steadily from the 1990s to reach 0.211 ppt in 2012. To date, the emission of this compound is not regulated.

The radiative efficiency (RE) of HFC-43-10mee has recently been re-evaluated at 0.42 W.m^{-2} ppb^{-1}, giving a 100-year time horizon global warming potential (GWP_{100}) of 1650. However, the initial RE, from which the new values were derived, originated from an unpublished source.

We calculated a new RE of 0.36 W.m^{-2} ppb^{-1} and a GWP_{100} of 1410 from laboratory absorption cross-section spectra of a pure vapour of HFC-43-10mee. Acquisitions were performed in the 550-3500 cm^{-1} spectral range using Fourier transform spectroscopy. The results were compared with the broadened spectra from the Pacific Northwest National Laboratory (PNNL) database and with theoretical calculations using density functional theory.

Keywords: HFC-43-10mee, 2H,3H-Perfluoropentane, 1,1,1,2,2,3,4,5,5,5-Decafluoropentane, hydrofluorocarbon, Absorption cross-section, Infrared spectroscopy, Density functional theory, Radiative efficiency, Global warming potential

1. Introduction

HFC-43-10mee (also known as 1,1,1,2,2,3,4,5,5,5-Decafluoropentane and 2H,3H-Perfluoropentane, $C_5H_2F_{10}$) is used as a cleaning solvent in electronics and has been investigated as an alternative nonflammable solvent for the recovery of uranium and plutonium [1]. Its estimated atmospheric lifetime is 16.1 years [2]. *In-situ* atmospheric measurements of HFC-43-10me have shown that the global mean tropospheric abundance reached 0.211 ± 0.046 ppt in 2012 [3].

The Fifth Assessment Report (AR5) of the United Nations Intergovernmental Panel on Climate Change [4] used a radiative efficiency (RE) of 0.42 W.m^{-2} ppb^{-1} that is based on an unpublished source. To verify this value, we acquired infrared cross-section spectra of a pure vapour of HFC-43-10mee at three temperatures. Composite absorption cross-section spectra have been

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