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INTERNAL ENERGY DEPENDENCE OF MOLECULAR CONDENSATION COEFFICIENTS DETERMINED FROM MOLECULAR BEAM SURFACE SCATTERING EXPERIMENTS

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ABSTRACT

An experiment has been performed which confirms the existence of an internal mode dependence of molecular sticking probabilities for collisions of molecules with a cold surface. The scattering of a velocity selected effusive beam of CCl_4 from a 90 K CCl_4 ice surface has been studied at five translational velocities and for two different internal temperatures. At a surface temperature of 90 K (~99% sticking probability) a four fold increase in reflected intensity was observed for the internally excited (560 K) CCl_4 relative to the room temperature (298 K) CCl_4 at a translational velocity of 2.5×10^4 cm/sec. For a surface temperature of 90 K all angular distributions were found to peak 15° superspecularly independent of incident velocity.

I. INTRODUCTION

The dynamics of gas-surface interactions can be studied in detail with molecular beam surface scattering techniques.[1] For example, data on surface residence times of trapped molecules, as well as velocity and angular distributions of scattered molecules, can all be obtained from beam-surface scattering experiments. With this information some very important questions relating to gas-surface interactions, such as gas-surface energy transfer, can be explored. At this time our main intent is to investigate whether, and to what extent, sticking probabilities for collisions of molecules with a cold surface depend upon the *internal* energy of the incident molecules. Recently, both theoretical[2] and experimental[3,4] investigations of this internal energy dependence have appeared in the literature. However, bulk kinetic experiments, such as those performed by the Russian groups, can not probe the detailed dynamics of the condensation process. Also, the internal energy effect reported in the laser excited BCl_3 experiment[4] has thus far not been observed in an attempted reproduction of that experiment.[5] In this paper an experiment will be described that directly confirms the existence of an internal energy