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Atomic and Molecular Collisions with Surfaces: Comparisons of Ar and N_2 Scattering from Ru(0001) HAILEMARIAM AMBAYE, WAYNE HAYES, J.R. MANSON, Clemson University — Recently reported molecular beams studies of Ar and N_2 scattering from Ru(0001) at thermal and hyperthermal energies exhibited a number of characteristics that are unusual in comparison to other systems for which molecular beams experiments have been carried out under similar conditions. For both systems the measured energy losses were unusually small and for Ar scattering in some cases quantum mechanical diffraction was observed under conditions for which it was not expected. These measurements are analyzed and compared to calculations with a mixed quantum-classical scattering theory. Many of the unusual features observed in the measurements are explained by the theory but only upon using an effective surface mass of 2.3 Ru atomic masses, which implies collective effects in the Ru crystal. The large effective mass, because it leads to substantially larger Debye-Waller factors, explains and confirms the observations of diffraction features. It also leads to the interesting conclusion that Ru is a metal for which molecular beams scattering measurements in the purely quantum mechanical regime, where diffraction and single-phonon creation are dominant, should be possible not only with He atoms, but with other atomic and molecular species with masses up to that of Ar atoms.

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