Decomposition of NO_2 on Palladium: The Kinetics of Oxygen and Nitrogen Atom Recombination at Steps & Terraces of Palladium

NO_2 is a significant environmental pollutant and a key intermediate in catalytic processes such as NOx Storage and Reduction (NSR) and Selective Catalytic Reduction (SCR), making its decomposition a crucial area of study for improving pollution control technologies and understanding surface reaction mechanisms. In addition, oxygen and nitrogen atom recombination plays a crucial role as a competitive process in several key catalytic reactions, but its kinetics have proven challenging to probe at the atomic scale. This study investigates oxygen and nitrogen recombination on two facets of palladium, Pd(332) & Pd(111), under ultra-high vacuum conditions using a novel pulsed molecular beam apparatus capable of collecting high repetition rate, velocity-resolved kinetics. In particular, we examine the decomposition of NO_2 on Pd surfaces as a pathway to study O_2 and N_2 recombination. Notably, surface temperature is controlled by laser heating, allowing access to higher temperatures while completely eliminating the large amounts of background signal that was unavoidable in previous electron bombardment heating methods.