V-V state-to-state rate constants in $N_2-N_2$ and $N_2-CO$ collisions in a wide temperature range: semiclassical calculations and analytical approximations

MARIO CACCIATORE, National Research Council- IMIP Bari, Italy, ALEXANDER K. KURNOSOV$^1$, ANATOLY NAPARTOVICH, SERGEY SHNYREV, Institute of Innovation and Fusion - Russia, CNR-INSTITUTE OF IN-ORGANIC METHODOLOGIES AND PLASMAS- BARI, ITALY TEAM, INSTITUTE OF INNOVATION AND FUSION - TROITSK-RUSSIA TEAM — Accurate semiclassical collision data for single- and multi-quantum vibrational state-selected V-V exchanges in $N_2(v)-N_2(u)$ and $N_2(v)-CO(u)$ collisions have been calculated over a large range of vibrational quantum numbers $(v, u)$ and gas temperature. Analytic approximations are also proposed that agree well with the semiclassical $[1]$ calculations performed for different classes of vibrational exchange processes, from near-resonant to far-from-resonance processes. The newly proposed analytical rate constants, together with the numerical ab initio rates, can be used with confidence in vibrational kinetic modeling of nitrogen and carbon monoxide-based gaseous systems, including plasmas sources in laboratory and in nature, under non-thermal equilibrium conditions.


$^1$Troitsk- Moscow region