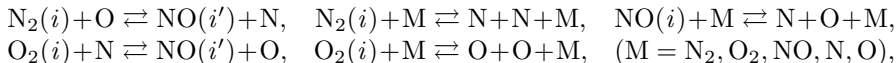
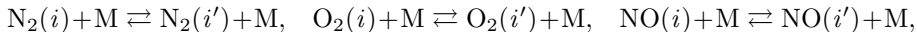


Kinetic processes in air mixture $N_2(i)/O_2(i)/NO(i)/N/O$

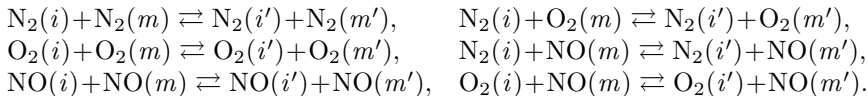
- Exchange reactions, dissociation and recombination:



- $TV(VT)$ exchanges between vibrational and translational energies:



- VV and VV' vibrational energy exchanges at the collisions of molecules of the same and various species:



Production terms in kinetic equations

- **Exchange reactions:**

$$R_{N_2i}^{2\leftrightarrow 2} = \sum_{i'=0}^{l_{NO}} (n_{NOi'} n_N k_{NOi',N_2i}^{N,O} - n_{N_2i} n_O k_{N_2i,NOi'}^{O,N}),$$

$$R_{O_2i}^{2\leftrightarrow 2} = \sum_{i'=0}^{l_{NO}} (n_{NOi'} n_O k_{NOi',O_2i}^{O,N} - n_{O_2i} n_N k_{O_2i,NOi'}^{N,O}),$$

$$R_{NOi}^{2\leftrightarrow 2} = \sum_{i'=0}^{l_{N_2}} (n_{N_2i'} n_O k_{N_2i',NOi}^{O,N} - n_{NOi} n_N k_{NOi,N_2i'}^{N,O}) + \sum_{i'=0}^{l_{O_2}} (n_{O_2i'} n_N k_{O_2i',NOi}^{N,O} - n_{NOi} n_O k_{NOi,O_2i'}^{O,N}).$$

- **Dissociation and recombination:**

$$R_{N_2i}^{2\leftrightarrow 3} = \sum_M n_M (n_N^2 k_{rec,N_2i}^M - n_{N_2i} k_{N_2i,diss}^M),$$

$$R_{O_2i}^{2\leftrightarrow 3} = \sum_M n_M (n_O^2 k_{rec,O_2i}^M - n_{O_2i} k_{O_2i,diss}^M),$$

$$R_{NOi}^{2\leftrightarrow 3} = \sum_M n_M (n_N n_O k_{rec,NOi}^M - n_{NOi} k_{NOi,diss}^M), \quad M = N_2, O_2, NO, N, O.$$

Production terms in kinetic equations

- **Energy exchanges:** $R_{ci}^{vibr} = R_{ci}^{VV} + R_{ci}^{VV'} + R_{ci}^{VT}$:

$$R_{ci}^{VV} = \sum_{mi'm'} \left(n_{ci'} n_{cm'} k_{c,i' \rightarrow i}^{c,m' \rightarrow m} - n_{ci} n_{cm} k_{c,i \rightarrow i'}^{c,m \rightarrow m'} \right), \quad c = \text{N}_2, \text{O}_2, \text{NO},$$

$$R_{ci}^{VV'} = \sum_d \sum_{mi'm'} \left(n_{ci'} n_{dm'} k_{c,i' \rightarrow i}^{d,m' \rightarrow m} - n_{ci} n_{dm} k_{c,i \rightarrow i'}^{d,m \rightarrow m'} \right), \quad d = \text{N}_2, \text{O}_2, \text{NO}, \quad d \neq c,$$

$$R_{ci}^{VT} = \sum_M \sum_{i'} n_M \left(n_{ci'} k_{c,i' \rightarrow i}^M - n_{ci} k_{c,i \rightarrow i'}^M \right), \quad M = \text{N}_2, \text{O}_2, \text{NO}, \text{N}, \text{O}.$$

- **Right parts in equations for atoms number densities:**

$$R_{\text{N}}^{2 \leftrightarrow 2} = - \sum_{i=0}^{l_{\text{N}_2}} R_{\text{N}_2 i}^{2 \leftrightarrow 2} + \sum_{i=0}^{l_{\text{O}_2}} R_{\text{O}_2 i}^{2 \leftrightarrow 2}, \quad R_{\text{N}}^{2 \leftrightarrow 3} = -2 \sum_{i=0}^{l_{\text{N}_2}} R_{\text{N}_2 i}^{2 \leftrightarrow 3} - \sum_{i=0}^{l_{\text{NO}}} R_{\text{NO} i}^{2 \leftrightarrow 3},$$

$$R_{\text{O}}^{2 \leftrightarrow 2} = - \sum_{i=0}^{l_{\text{O}_2}} R_{\text{O}_2 i}^{2 \leftrightarrow 2} + \sum_{i=0}^{l_{\text{N}_2}} R_{\text{N}_2 i}^{2 \leftrightarrow 2}, \quad R_{\text{O}}^{2 \leftrightarrow 3} = -2 \sum_{i=0}^{l_{\text{O}_2}} R_{\text{O}_2 i}^{2 \leftrightarrow 3} - \sum_{i=0}^{l_{\text{NO}}} R_{\text{NO} i}^{2 \leftrightarrow 3}.$$