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Wide Temperature Range Kinetics of Plume Reactions

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Abstract: The kinetics of reactions leading to the CO Fourth Positive vacuum ultraviolet emission is studied for incorporation in plume radiation models. A fast-flow reactor and a high temperature, pseudo-static, photochemistry reactor have been used. Experiments with the former on the O + C₂H₂ reaction have shown that the intensity of the CO Triplet bands decreases with increasing pressure. This is in accord with the proposed mechanism for CO formation, by collision-induced curve crossing from CO triplet states. Experiments in the pseudo-static reactor have confirmed the increase of the CO **chemiluminescence** intensity with pressure, as indicated by this mechanism, but show a decrease in the intensity of the emission when the C₂ + O₂ reaction is investigated instead. This indicates a direct CO formation in the latter reaction, which leads to more intense vuv emission and may be a more important reaction for rocket exhausts. As the first step toward obtaining the absolute light intensities and **chemiluminescence** efficiencies for the C₂ + O₂ reaction, its vuv emission is used to obtain its overall rate coefficients, $k(300-976\text{ K}) = 1.8 \times 10 \exp(-11)(\exp-451\text{ K/T})\text{ cm}^3/(\text{molecule}\cdot\text{s})$. These values are in excellent agreement with earlier experiments, where the C₂ consumption rate coefficients were measured instead.

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