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On the upper atmospheric chemiluminescent emission observed upon release of aluminum vapor and its compounds

[Gole, J. L.](#); [Kolb, C. E.](#)

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Upper atmospheric chemical releases of aluminum vapor and gaseous aluminum compounds have been used to determine a number of atmospheric properties in the 90 to 220-km altitude range. Visible radiation from nighttime releases is due to a chemiluminescent reaction which has been traditionally identified as the radiative combination of AlO with atomic oxygen to form electronically excited AlO₂. Atmospheric release data are reviewed which eliminate this traditional mechanism. Results from laboratory experiments are presented which indicate key roles for electronically excited HAlOH formed in a direct insertion reaction of atomic aluminum with water vapor and AlO (asterisk)(A₂π) formed via the reaction of oxygen atoms with weakly bound aluminum adducts. These new mechanisms significantly influence the nature of input data for atmospheric models.

Keywords: ALUMINUM, ATMOSPHERIC CHEMISTRY, CHEMILUMINESCENCE, METAL VAPORS, NIGHTGLOW, UPPER ATMOSPHERE, ALUMINUM COMPOUNDS, ATMOSPHERIC MODELS, MOLECULAR EXCITATION, OXYGEN RECOMBINATION, REACTION KINETICS, SPECTRUM ANALYSIS, WATER VAPOR

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