The Dissociative Recombination of O_2^+ and the Oxygen Green Airglow: A Surprising Dependence on Electron Temperature

Robert Peverall[1], Stefan Rosen[2], James R. Peterson[3], Mats Larsson[2], Liliana Vikor[2], Jacek Semaniak[2], Arnaud Le Padellec[2], Håkan Danared[4], Magnus af Ugglas[4], Ahmed Al-Khalili[2], Rolf Bobbenkamp[5], Ahilleas Maurellis[1], Steven L. Guberman[6] and Wim van der Zande[1]

[1]FOM institute for Atomic and Molecular Physics, Kruislaan 407, 1098 SJ Amsterdam, The Netherlands
[2]Department of Physics, Stockholm University, Box 6730, S-113 85, Stockholm, Sweden
[3]Molecular Physics Laboratory, SRI-International, Menlo Park, CA 94205, USA
[4]Manne Siegbahn Laboratory, Stockholm University, S-l04 05 Stockholm, Sweden
[5]Faculty of Physics, University of Bielefeld, 33615 Bielefeld
[6]Institute for Scientific Research, 33 Bedford St, Lexington, MA 02420, USA

The dissociation dynamics in the dissociative recombination (DR) of O_2^+ have been studied in fine detail using the ion storage cine CRYRING at the Manne Siegbahn Laboratory (Stockholm). The branching behaviour has been determined in an energy region between 0 and 100 meV, concentrating on the first 40 meV. The O(^{1}S) yield displays a strong dependence on the electron energy, in contrast to the O(^{1}D) yield. This makes the relative determination of O(^{1}S) and O(^{1}D) a measure of the electron energy temperature. The production of excited atomic oxygen O(^{1}S) gives rise to the O(^{1}S) $\rightarrow$ O(^{1}S) 557.7 nm (green) transition above 120 km, which is much weaker than the green airglow due to oxygen atom recombination around 100 km but dominates above 140 km. The experimental findings are found to agree surprisingly with current (new) theory as developed by Guberman.