Stuttgarter Physikalisches Kolloquium
Fachbereich Physik, Universität Stuttgart
Max-Planck-Institute für Festkörper- und Metallforschung
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Origin and Evolution of the Atmosphere

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Abstract

Earth's atmosphere is a disequilibrium mixture of oxidizable materials in the presence of large amounts of oxygen. The entropy reduction is brought about by living organisms using photochemical energy from the sun. Almost all the oxygen in the atmosphere is derived from photosynthesis; inorganic photochemistry can produce only 10^{-9} of the present atmospheric level at most. Oxygen is a critical component of our atmosphere, not so much because some living organisms employ respiration, but because O_2 is a precursor of atmospheric O_3. Between them, O_2 and O_3 filter out short-wavelength UV radiation from the sun, and so permit the existence of life on dry land.

This lecture looks at atmospheric chemistry from a viewpoint that differs from the one usually adopted. Here, the way in which we came to possess the atmosphere we have at present is explored. Evolution of the atmosphere is shown to involve factors such as (i) the trapping of solar infrared radiation by 'greenhouse' gases; and (ii) the protection of living organisms on the surface of the planet by a shield of ozone present mainly in a layer within the stratosphere. These two examples are reflected by current concerns about how Man's activities could (i) alter atmospheric concentrations of radiatively active species, and thus bring about climate change; and (ii) increase the concentrations of stratospheric catalysts that destroy ozone, leading to a global decrease of the protective layer and the generation of the 'ozone holes' observed in polar regions.