A New Method of Producing Negative Ions

In some recent experiments on the bombardment of metal surfaces with positive ions, negative ions formed at the surface by the positive ion impacts were observed. The apparatus used was an adaptation of the Dempster type mass spectrograph in which the negative particles formed could be analysed. Platinum targets were used in most cases and the impacting ions were of lithium (chiefly Li_7^+) produced by a spodumene source on a hot filament. The positive ions were accelerated through 500 volts to the target where any negative particles formed would be driven back to the first slit of the mass spectrograph with the same velocity as the impinging positives. Identification of the negative particles was made from the calibration of the spectrograph with known positive ions. All experiments were made in a good vacuum of the order of 10^{-6} mm of mercury.

In this way negative ions of $OH^-=17$ and $Cl^-=35$ were found to result from the bombardment with positive lithium ions. Secondary electrons were also observed together with two ions which were probably H_1^- and H_2^-; the latter two ions were not easily analysed due to the width of the slits and the small values of the magnetic field at which they were observed. For platinum targets which had not been outgassed the negative OH ion was strong and steady over a period of several hours; its intensity was of the same order of magnitude as the electron emission. The H_1 and H_2 ions accompanied the OH ion, H_1 being several times as intense as H_2. The Cl ion was not resolved into its components and was not always observed; its presence was more noticeable when the target was coated with spodumene showing that it probably arose from some chance contamination of the target. Strong outgassing of the platinum target did not affect the electron emission but caused the negative ions to disappear.

This method of forming negative ions while of interest in itself may also be of importance in interpreting related experiments. It is possible that in studies of ionization and secondary electrons produced by positive ions this type of emission may contribute to the effects observed. The general presence of water vapor in most metals and compounds will probably give rise to negative ions as well as electrons while the negative chlorine ion indicates that other substances may form other ions under the influence of positive ion bombardment.

Negative ions have been observed previously by J. J. Thomson[1] and O. H. Smith[2] as the retrograde rays formed in discharge tubes. These ions, presumably of H_2^- and O_2^-, were formed just in front of the cathode by gas molecules acquiring a negative charge. O. W. Richardson[3] and H. A. Barton[4] have reported a few cases of negative ions formed by direct heating of the salt. Very recently Mueller and Smyth[5] have reported negative hydrogen and hydroxyl ions formed by electron impacts in apparatus containing water vapor. Further work on this type of emission is being carried out and will be reported on later.

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[1] J. J. Thomson, "Rays of Positive Electricity," pp. 137–138.

[2] O. H. Smith, Phys. Rev. **7**, 625 (1916).

[3] O. W. Richardson, "Emission of Electricity from Hot Bodies."

[4] H. A. Barton, Phys. Rev. **26**, 360 (1925).

[5] D. W. Mueller and H. D. Smyth, Program of Schenectady Meeting, American Physical Society, Abstract 11, Aug. 26, 1931.

Variations in the Grating Constant of Calcite Crystals

With the development of the double crystal spectrometer for measuring x-ray wavelengths and the use of the high precision photographic spectrometers now employed, the question of a possible variation in the grating constant of calcite is of considerable importance. Also the chemical purity and density of the crystals should be examined.

In the present experiments optically clear crystals have been secured from four localities, Iceland, Spain, Montana, and Argentina. The crystals were carefully cleaved and the part of the surface used for diffracting the x-rays was almost free from "steps." Small pieces of each crystal were cut from a region very close to the part of the crystal used and a chemical