THE WALL-STABILIZED HYDROGEN ARC AS A RADIATION STANDARD IN THE VACUUM UV

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Extensive calculations of the radiative emission of an atmospheric pressure hydrogen arc in the temperature range from 8000 to 15000 K have been undertaken, which show that a partly ionized hydrogen arc plasma may serve as an intense and accurate spectral radiation standard in the ultraviolet. The principal features of the spectrum are: Between 1215 Å and 3600 Å the hydrogen arc emits only continuous radiation, dominated by the Balmer recombination continuum. Between 1215 Å and 930 Å the lower members of the Lyman series appear strongly Stark-broadened and optically thick in their central parts. The higher Lyman lines merge into a quasi-continuum, which leads into the very strong Lyman continuum. Between 930 and about 400 Å the continuum is optically thick, i.e., it represents blackbody radiation at typical arc temperatures of 12000 to 15000 K.

The wall-stabilized hydrogen arc may be operated for long periods of time and is extremely stable. For calibrating purposes the arc is best connected in an end-on configuration directly to the vacuum uv spectrometer. For wavelengths above 1150 Å the two instruments may be conveniently separated by a LiF window, but for shorter wavelengths a windowless connection with a differential pumping system becomes necessary. The diagnostic measurements of the arc plasma are done by side-on observations in the visible for which an additional monochromator is employed.

The hydrogen arc offers two principal advantages against other available standards: (1) It emits essentially only continuous radiation, except for about eight to ten Lyman lines, and thus permits a calibration at any desired wavelength. (2) All atomic emission coefficients and other parameters for the diagnostic measurements are very accurately known, so that this source is capable of high accuracy. It is estimated that for the intensity calibrations accuracies of 9% at 2000 Å, 12% at 1000 Å, and 25% at 500 Å may be attained.

DISCUSSION

W. Hofmann: Since the temperature dependence of the intensity of the hydrogen emission is approximately the same as for optically thick lines, does the better accuracy come from better temperature measurement?

W. L. Wiese: The improvement in accuracy against Boldt's method of using optically thick lines is principally due to the application of hydrogen. On a pure hydrogen arc the most accurate plasma diagnostics may be performed, since its atomic parameters, like transition probabilities and continuous absorption coefficients are exactly known.

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