



Phosphorus in Steels

Conventional spectrographic methods of analysis, although used for the rapid control of most alloying elements in steel, have not been applicable to the determination of phosphorus. However, reports in the literature as early as 1941 indicated that Geiger-Müller photoelectron counters used in combination with a spectrograph could readily detect and measure ultraviolet wave-lengths in the region where several phosphorus lines exist.

Small rod-shaped samples, poured from molten metal, are excited in an electric arc. The radiation from the arc is dispersed and the phosphorus line of $2136.2 \text{ \AA}$ is directed into the quartz-enveloped Geiger tube. The photoelectric cathode of the tube emits current pulses at a rate proportional to the amount of phosphorus radiation striking the tube. The number of pulses (or counts) in a given length of time indicates the percent of phosphorus in the sample of metal. A determination can be made within two minutes, and as little as 0.005% of phosphorus can be detected in a specimen of steel. Temperature control of the quartz prism and stabilization of arc conditions are major considerations in obtaining high accuracy.

Geiger-Müller counters provide the means of further rapid measurements in spectral regions where photographic plates and multiplier phototubes are impractical.

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Industrial Application of Geiger-Müller Counters to the Analysis of Phosphorus in Steels

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Plasticity in Metals

Two groups of theories have been proposed to explain the way metals harden when they are deformed at temperatures below that in which they undergo change in their crystal structure: they are the theories of plastic deformation and theories of plastic flow. Under the special conditions prevailing with the customary arrangements for testing materials under combined stresses, the theories of both groups furnish identical predictions, and the available empirical evidence of more general character is

too limited to allow a definite decision in favor of one or the other group.

Any theory of plasticity must use different stress-strain relations for loading and unloading. Since a neutral change of stress may be considered as a limiting case of either loading or unloading, the stress-strain relations for loading and unloading should furnish the same result when applied to the same neutral state of stress. The paper summarized here contains the proof that this condition is not satisfied by the theories of plastic deformation. This constitutes a strong argument in favor of the theories of plastic flow.

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Theory of Plastic Flow Versus Theory of Plastic Deformation

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Plastic Optical Elements

One of the achievements in the field of optics during World War II was the use of plastic optical elements. A disadvantage that had to be overcome is that plastic lens elements change their focal length with temperature more markedly than do similar glass elements. The solution was to 'athermalize' the optical system in a manner similar to that by which lens systems are achromatized. Two or more elements with different thermal properties are combined so that their reactions compensate for each other with a change of temperature. Generally this would require that the optical system satisfy new conditions, requiring extra lens elements, or performance would be inferior.

The present paper describes methods of athermalizing without complications in lens design or loss of lens performance. One glass lens component may be used in the otherwise plastic lens system. If the lens elements are all of plastic and if the coefficients of thermal and chromatic dispersion of the optical materials are in proportion, the lens system will be athermalized when it is achromatized. Also, a concave mirror may be spaced from its focal surface by material having the same coefficient of thermal expansion as the mirror to compensate for the change of mirror curvature with temperature.

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Athermalization of Optical Systems

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