# AFFIDAVIT OF Pamela Stansbury

STATE OF NEW YORK )
) ss.
COUNTY OF TOMPKINS )

Pamela Stansbury being of full age and duly sworn, deposes and says as follows:

1. I am an employee of the Cornell University Library, and specifically Library Technical Services, located at Cornell University, Ithaca, New York 14853. I have personal knowledge of the facts set forth below.

2. I am the Administrative Supervisor in Library Technical Services, which maintains bibliographical and processing information for many historical documents. I have held such position since 1996.

3. Included in the Library's historical collection are various publications. As part of that collection, the Library maintains custody of an original issue of **Journal of the Illuminating Engineering Society, Volume 6, Issue 2 (January 1977)**, which includes the paper ***Improved Color Rendition In High Pressure Mercury Vapor Lamps*** / by Mary Hoffman.

4. Mr. Richard F. Moncrief requested information about **Journal of the Illuminating Engineering Society, Volume 6, Issue 2 (January 1977)** – specifically when this item was first made publicly available by the Library. As best I can determine, the publication was publicly available at the Cornell University Library as January 21, 1977.

Pamela T. Stansbury (signature)
Pamela T. Stansbury (name printed)

Sworn to before me this
13th day of December 2016

Lyndsi R Prignon
Notary Public

LYNDSI R. PRIGNON
Notary Public, State of New York
No. 01PR6069103
Qualified in Tompkins County
Commission Expires January 22, 2018

Volume 6/Number 2 January 1977



# JOURNAL
## of the Illuminating Engineering Society

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# Improved color rendition in high pressure mercury vapor lamps

Mary V. Hoffman

**The addition of $Y_3Al_5O_{12}$:Ce to the group of phosphors suitable for color correcting the mercury discharge lamp provides for improving the color rendering index without a lumen loss. By altering the cerium content in the formulation, the absorption and brightness can be adjusted to its optimum value in the lamp.**

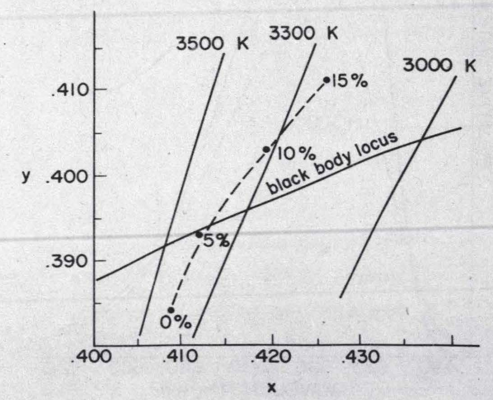
The ideal in color rendition of a high pressure mercury discharge lamp has been the subject of several recent papers, in which simulated spectral distributions have been created by the addition or subtraction of spectral energy.[1,2] This can be done to obtain lamps of selected color temperatures, with various combinations of real and simulated phosphor emissions. The optimization of the luminous efficiency can be calculated in the same manner. One study has shown that the addition of emission at 620 nanometers to the Hg discharge is near the optimum for color rendition, but that for lamps with color temperature of 4000 to 3000 kelvins, it is necessary to remove some of the Hg discharge in the blue. For luminosity, addition of emission near 590 nanometers is needed.[2,3]

Among the existing phosphors meeting the temperature and stability requirements of the mercury discharge lamps, only Y $VO_4$:Eu and $Y(VP)O_4$:Eu phosphors (YVP) supply emission at the necessary spectral region, with the main peak at 618 nanometers. They do not provide absorption of the blue Hg lines in sufficient amount or emission in the high luminous region. Filtering of the blue can be obtained by the addition of a pigment or of a phosphor which also acts as a pigment. The phosphor magnesium fluogermanate activated with manganese (MG) is the only suitable red emitter with appreciable absorption of the blue lines, but since the emission is at 650 to 660 nanometers, the luminosity is not enhanced by this substitution. Combinations of these two phosphors can be used, as described by Rokosz, *et al.*[4]

We have found another phosphor, cerium-activated yttrium aluminate garnet (YAG:Ce) which is useful in improving color rendition by absorbing the blue Hg radiation and also adds to the total emission of the lamp by converting this blue radiation into emission centered at 560 nanometers. It can be combined with the $Y(VP)O_4$:Eu emission, effectively changing the color of the lamp.

Lamps prepared with blends of YAG:Ce and YVP phosphors show the shift in color points from below the black body to, on, or above the locus, depending on the proportions used. Typical color points are shown in Fig. 1 for a warm color corrected lamp. The

**Figure 1. Color shifts with increasing YAG:Ce in $Y(VP)O_4$:Eu.**




A paper presented at the Annual IES Conference, August 29 through September 2, 1976, Cleveland, Ohio. AUTHOR: General Electric Company, Cleveland, Ohio.

color shift is due largely to the absorption of the 436 nanometer Hg line, which is filtered by about 40 percent with 15 percent YAG in the blend. The luminosity of the lamps remains about the same for four lamp colors shown. This is due to the efficient conversion of the 436 Hg line into visible emission. These data are summarized in Table I.

The actual color points obtained can be varied by the amount of phosphor used on the lamp as well as the proportion of YAG:Ce in the blend. It can also be varied by using the blend over a pre-coat, as described by Rokosz, *et al.*[4] The pre-coat acts as a reflector for both ultraviolet and the blue radiation, allowing better utilization of the Hg radiation by the phosphors. With the YAG:Ce present, the reflection of the blue radiation increases its effect both as a pigment and as a phosphor.

The YAG:Ce phosphor, which was developed for its emission characteristics under cathode ray excitation[5,6] is strongly absorbing in the blue, as shown

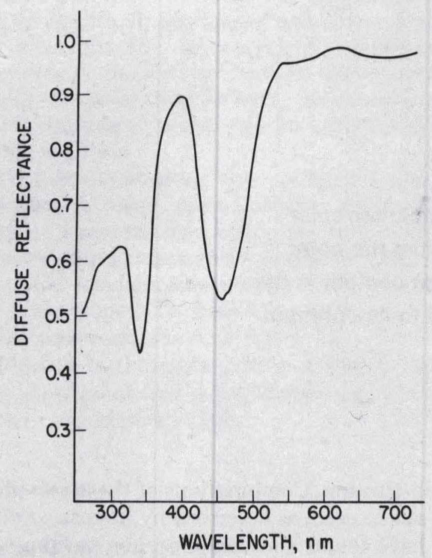



**Figure 2. Diffuse Reflectance curve, $(Y_{2.925}\ Ce_{0.075})_3\ Al_5O_{12}$.**

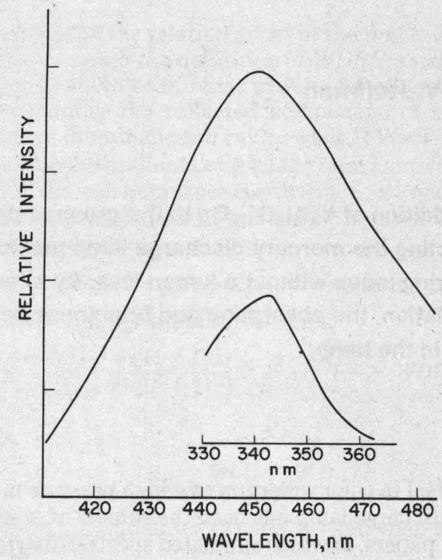



**Figure 3. Excitation curve: detected wavelength—511 nanometers.**

**Figure 4. Emission curve: excitation wavelength—436 nanometers.**

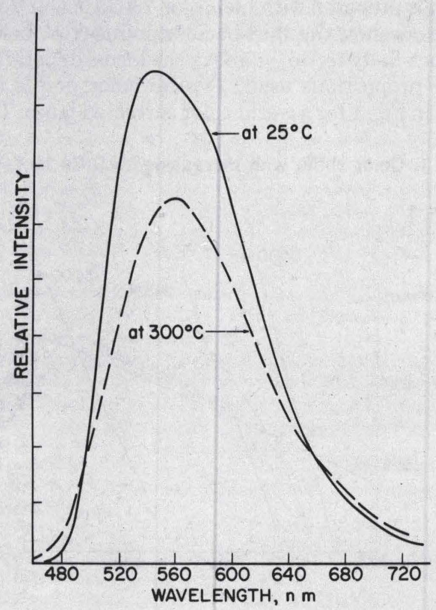
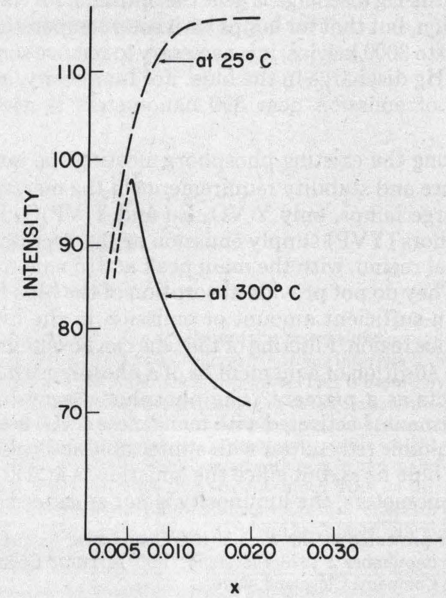



**Figure 5. Emission intensity *vs* cerium content, measured at 25° C and 300° C. Excitation wavelength—436 nm.**



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