SPECULAR REFLECTANCE OF MIRRORS

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This note describes an experimental method and some preliminary results thereby obtained in an investigation of mirror materials for a solar power station that will employ a distributed array of concentrators (1,2). The mirrors ultimately used in this application must specularly reflect a high percentage of the incident solar radiation and either the reflectance must not irreversibly deteriorate excessively over the lifetime of the power station or the mirror surface must be replaceable.

The apparatus used to evaluate specular reflectance is shown in Figure 1. The light used in the present studies, obtained from a helium-neon laser, has a wavelength of 6328 Å.** Using this apparatus, the scattering of light about the angle of reflection may be evaluated, and the angle of incidence may also be varied. The photomultiplier light detector, with a 0.3 mm slit, has an acceptance angle of 0.55 milliradians. For calibration of the apparatus, the photomultiplier arm is rotated to align with the laser beam directly.

Figure 2 illustrates the data obtained using no mirror (calibration position)

Figure 1. Apparatus for studying specular reflectance and light scattering.

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**Additional experiments using monochromatic light at wavelengths over the solar spectrum are in progress.

Key words: solar energy, reflectance, specularity, mirror.

Figure 2. Intensity vs. Angle.
A. No Mirror - Calibration Position
B. Evaporated Aluminium - Quartz Over coat, Not Weathered
C. As in B - Weathered 31 Days

and using a front-surface mirror (45° incident angle) of evaporated aluminium (600 Å thick) with a quartz overcoat (1/20 wave thick).* The degradation of reflectance after natural weathering at an inclined angle of 10°, facing north, in the Canberra, Australia environment for 31 summer days is evident - the specular reflectance (measured by the peak intensity) decreases from 86% to 75%.

To determine the effect of cleaning the surface on increasing the specular reflectance, cleaning was attempted by directing a jet of distilled water and also of a 3% potassium oleate solution from a squeeze-bottle. The effects were negligible. On the other hand, scrubbing with cotton wool soaked in the soap solution, followed by rinsing with distilled water, caused the specular reflectance to increase to 85%. These experiments tend to indicate that cleaning methods - to be effective - will require mechanical action, which may be obtained either by liquid spray operating at high pressure or by wipers similar to those used in window cleaning procedures.

REFERENCES

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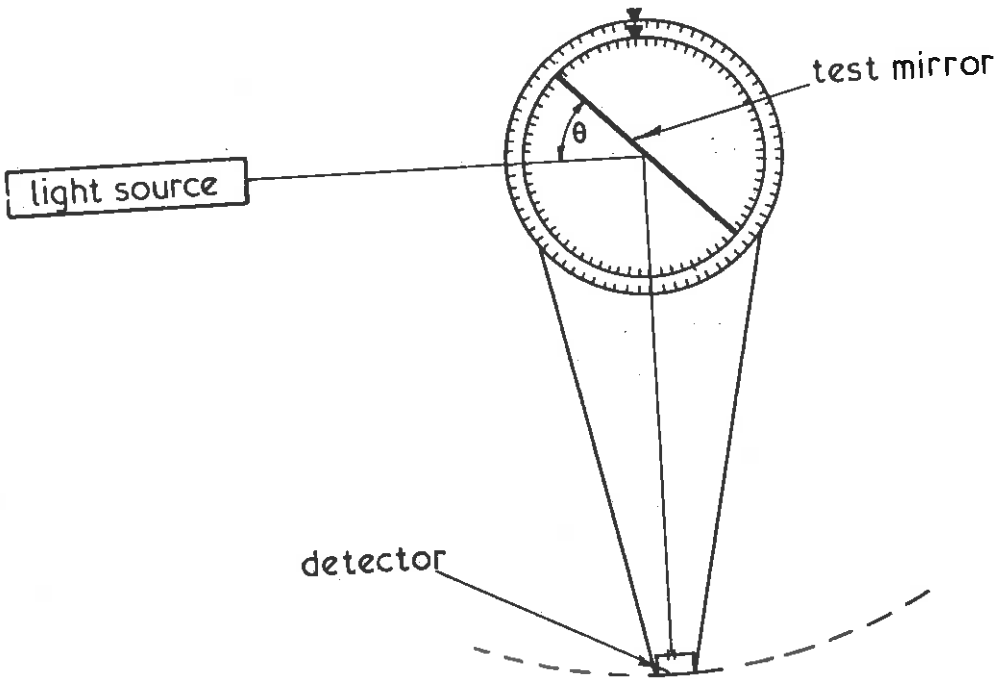
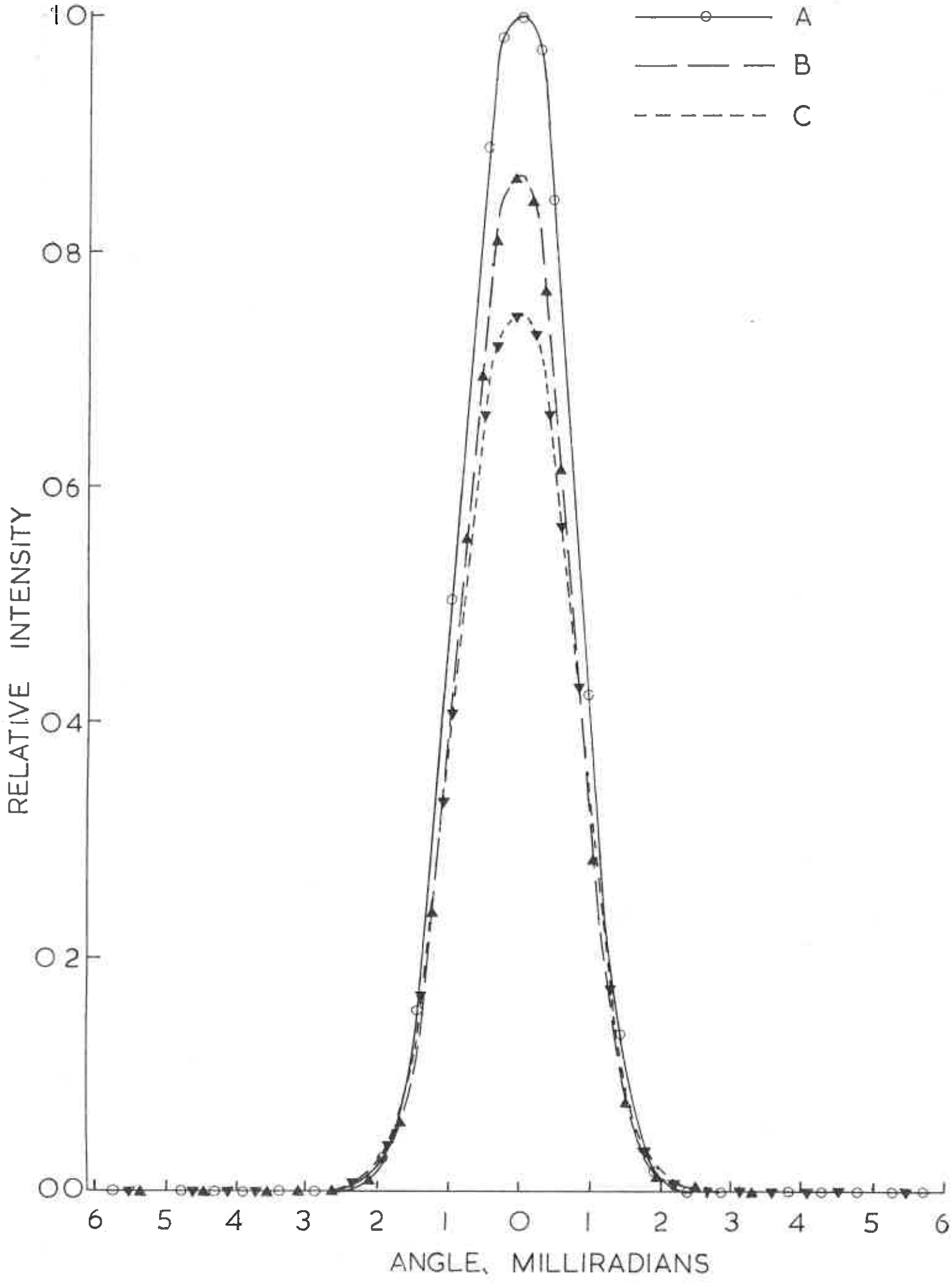
(2) P.O.Carden, A large Scale Solar Plant Based on the Dissociation and Synthesis of Ammonia, Energy Conversion Tech. Rep. No.8, Research School of Physical Sciences, The Australian National University, Canberra, Australia, November, (1974).

*Obtained from Libbey-Owens-Ford Company, Toledo, Ohio.


test mirror
θ
light source
detector


A
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C
1.0
0.8
0.6
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RELATIVE INTENSITY
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