allowed to elapse before beginning the counting so that short-lived activities could decay out. The decay curve is a pure exponential. Observations taken twenty-four and forty-eight hours after irradiation showed no counts above the number expected on the assumption that the only activity present was 140-min Dy^{165}. A least-squares analysis of the decay curve yielded a half-life for Dy^{165} of 139.17±0.14 min, in agreement with recent values (140±1.5 min, 145±3 min) obtained by Bothe[1] and Slätis.[2] We wish to thank V. Walsh and M. Turso for their assistance in the experiment.

† Work done under the auspices of the AEC.

1 W. Bothe, Z. Naturforsch. 1, 179 (1946).
2 H. Slätis, Arkiv. Mat. Astron. Fysik 33A, No. 17 (1947).

Gamma-Gamma Angular Correlation in Cd^{114}

E. D. KLEMA AND F. K. MCGOWAN
Oak Ridge National Laboratory, Oak Ridge, Tennessee

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THE angular correlation of the gamma-rays emitted in cascade from the excited states of Cd^{114} has been measured with the apparatus described previously.[1] The source used was an aqueous solution of $InCl_3$ in a Lucite container, and the gamma-rays were detected with sodium iodide crystals 1½ inches in diameter and 1 inch long at a distance of 10 centimeters from the source. The data were taken at increments of 10° from 90° to 160°, and each detector was set on integral at the lower edge of the photo peak due to the 548-kev gamma-ray. Under these conditions the effect of the annihilation radiation is to raise the coincidence rate at 180° by 40 percent. A total of 100,000 coincidence counts was observed.

The data were fitted by least squares to an expansion in terms of Legendre polynomials. The correlation is given by $W(\theta)=1+0.111P_2(\cos\theta)+0.023P_4(\cos\theta)$ or $W(\theta)=1+0.084\cos^2\theta+0.106\times\cos^4\theta$, in which the angular resolution of the apparatus has been taken into account.

The above correlation is consistent with a spin assignment of 0–2–2 for the ground state and the two excited states of Cd^{114}, respectively. The first gamma-ray of the cascade is a mixture of 97 percent magnetic dipole and 3 percent electric quadrupole radiation with the electric and magnetic components in phase.

The intensity of the crossover gamma-ray relative to the main cascade has been measured with a sodium iodide scintillation spectrometer and found to be about 6 percent.

The correlation of the gamma-rays from Cd^{114} has been measured previously by Steffen.[2] He has repeated these measurements, and his new results are in agreement with those of the present work.[3]

1 McGowan, Klema, and Bell, Phys. Rev. 85, 152 (1952).
2 Rolf M. Steffen, Phys. Rev. 83, 166 (1951).
3 Rolf M. Steffen, private communication.

Mechanical Properties of Thin Films of Silver*

J. W. BEAMS, W. E. WALKER, AND H. S. MORTON, JR.
University of Virginia, Charlottesville, Virginia

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IN the study of the mechanical properties of thin films it is important to apply the stress uniformly in order to prevent "tearing" or other forms of stress concentration. This is especially true in the determination of the tensile strength of thin metallic films or in the measurement of the adhesion of these films to other metals. One simple method of applying the stresses to such metallic films is to subject them to high centrifugal fields. The method previously described in detail[1] of spinning magnetically suspended rotors in a vacuum or in gases at various pressures is ideal for this kind of investigation because accurately known stresses can be applied uniformly and at almost any desired rate. Also the usable rotor speeds are limited only by the bursting strength of the rotors.

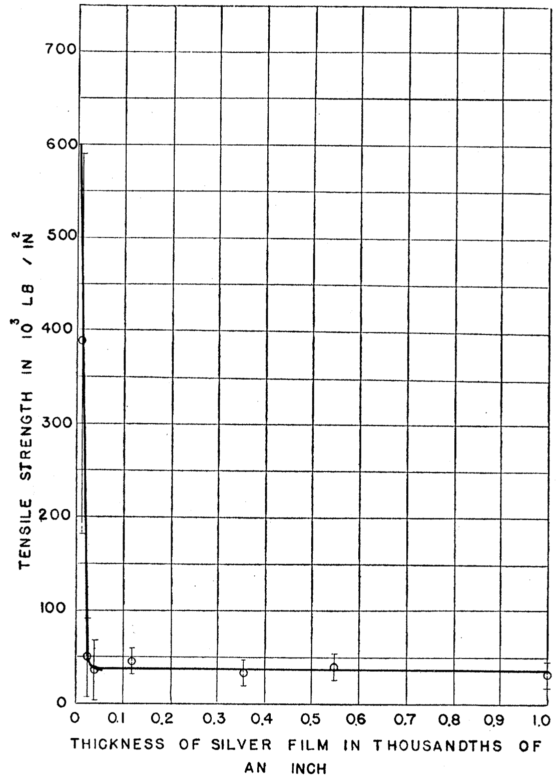

FIG. 1. Tensile strength as function of thickness.

In the experiments described here films of silver of uniform thickness were electro-deposited on small cylindrical steel rotors with rounded ends and the rotational speeds required to throw them off of the rotors were measured. The rotors were spun in a high vacuum. It can be shown that

$$4\pi^2N^2R^2d=T+(AR/h),$$

where N is the rotor speed in rps, R is the rotor radius, d the density of the deposited film, h the thickness of the film, T the tensile strength of the film, and A the adhesion. Consequently, by using rotors with different diameters and measuring the speeds at which the metallic films are thrown off of the rotor, it is possible to determine both the tensile strength T and the adhesion A.

It will be observed that if the ratio of the rotor radius to the thickness of the film is large even a small adhesion A makes the last term overshadow the first. Consequently, we have employed comparatively small rotors for these experiments. Also, by using well-known procedures in the electro-plating process uniform films of silver could be deposited on the steel rotors, which had relatively small adhesion. Figure 1 shows a plot of the tensile strength T *versus* the thickness h of silver films deposited on steel rotors 0.125 inch and 0.093 inch in diameter, respectively. It will be observed that the maximum tensile strength of the film is approximately constant down to thicknesses of about 2×10^{-5} inch, then markedly increases. For thicknesses greater than 2×10^{-5} inch the tensile strength is a little above the average of 18,200 lb/in.^{2} given in the tables[2] for annealed silver wire while for the films 2×10^{-5} inch thick, the minimum tensile strength measured was 104,000 lb/in.^{2}. For film thicknesses less than 2×10^{-5} inch, the tensile strength continues to increase.

It is well known[3] that very small fibers of glass and of some metals have higher tensile strengths than the bulk materials. Also, extremely thin films of mica are known to be very strong.[4]