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Measurement of general forms of motion by laser speckle interferometry

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In this paper, using laser speckle interferometry, we have analysed the combination of ramp motion and sinusoidal vibration, sinusoidal motion with constant acceleration, step motion and damped vibration. The results are presented graphically. For higher values of speckle contrast, it is observed in all cases, that the intensity distribution is similar to that as exists in the case of conventional time average hologram interferometry.

1. INTRODUCTION

Speckle is the result of superposition of waves of random amplitude and phase scattered by the object. It is a universal nuisance in holography. But now it is a well established fact that the speckle is not noise but some thing which gives extra information that we do not need. Many workers applied this effect in studying surface roughness, vibration and motion analysis (Singh 1972).

Following Massey (1968), Archbold *et al* (1969) have reported a laser speckle interferometer to observe the nodes on a diffusely reflecting surface. Ek & Molin (1971) have concluded that the amplitude also can be measured using the same experimental set up. Recently Gupta & Singh (1976) have applied this technique in analysing the constant velocity of motion, quadratic motion and non-sinusoidal periodic vibrations. In this paper we have discussed the combination of ramp motion and sinusoidal vibration, sinusoidal motion with constant acceleration, step motion and damped vibration. In all the cases the results are given graphically.

2. THEORY

Following Ek & Molin (1971) Gupta & Singh (1976) have shown that when the object is illuminated and viewed along the surface normal, the speckle contrast is expressed as

$$C' = \{1+2\alpha|C|^2\}/(1+\alpha) \qquad \ldots \quad (1)$$

where α is the ratio between the irradiance of object and reference beams and C, the characteristic fringe function which is given by eq. (6)

$$C = \frac{1}{T}\int_0^T \exp i\left[\frac{4\pi}{\lambda}x(t)\right] dt \qquad (2)$$

the stress σ is calculated using the previous expression in which $\lambda_s = -62\times10^{-6}$ (Yamamato *et al* 1953). Figure 5(b) shows a plot of calculated stress σ as a

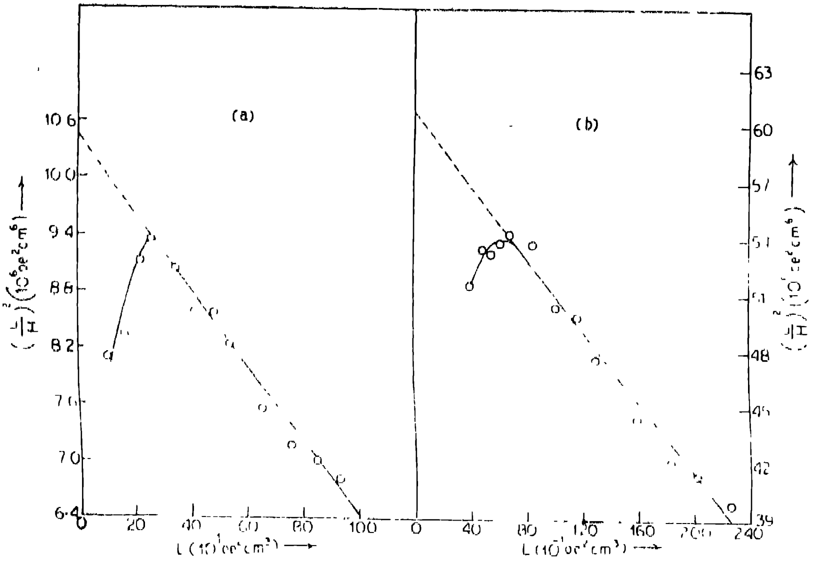

Fig. 3. $(L/H)^2$ versus L in Cobalt films of magnetic thickness (a) 242.0 Å and (b) 583.0 Å.

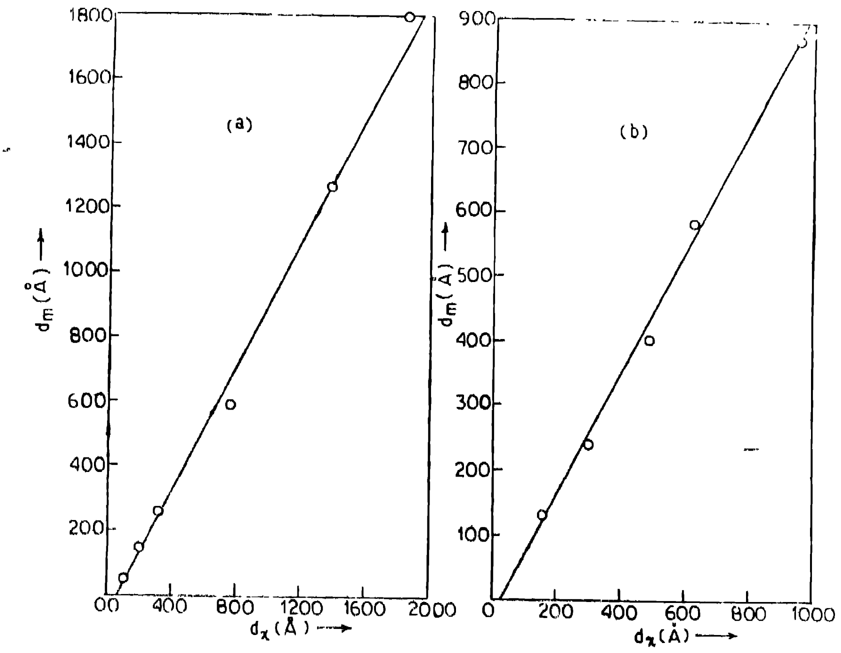

Fig. 4. Magnetic thickness versus actual thickness of (a) Nickel and (b) Cobalt.

function of d_m. Stress goes through a minimum consistent with the thickness dependence of average intrinsic stress of Cobalt films determined directly using *in-situ* cantilever technique by Klokholm & Berry (1968). It is therefore suggested

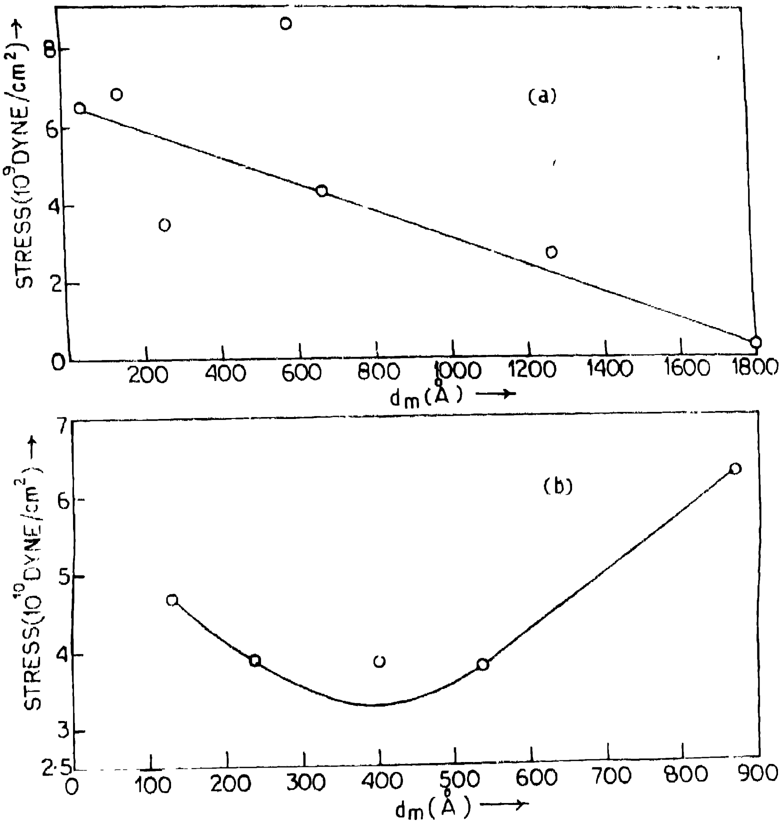

Fig. 5. Calculated internal stress as a function of magnetic thickness in (a) Nickel and (b) Cobalt films.

that $K_\perp$ arises mostly from the strain-magnetostriction mechanism. However, the increase in stress for higher thickness is more pronounced in the present case.

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REFERENCES

Cranglo J. & Goodman C. M. 1970 *Bull. Amer. Phys. Soc.*, **15**, 269.

Danan H. A. & Moyer A. J. P. 1968 *J. Appl. Phys.*, **39**, 669.

Goddard J. & Wright W. G. 1964 *Brit. J. Appl. Phys.*, **15**, 807.

Jayaraman V. & Dutta Roy S. K. 1976 *Ind. J. Pure & Appl. Phys* (in Press).

Klokholm E. & Berry B. S. 1968 *J. Electrochem. Soc.*, **115**, 823.

Maeda H. 1970 *J. Phys. Soc. Japan*, **29**, 311.

Mayadas A. F. & Klokholm E. 1968 *J. Appl. Phys.*, **39**, 201.

Meyers H. P. & Sucksmith W. 1951 *Proc. Roy. Soc.* (*London*), Ser. **A207**, 427.

Neugebauer C. A. 1959 *Phys. Rev.*, **116**, 1441.

Rosotte K. H. & Hoffman R. W. 1961 Symp. *Electric and Magnetic properties of thin films* (Quoted by Prutton M. 1964 in 'Thin Ferro-magnetic films' Buuterworth Co., *p.* 253).

Rusko W. 1958 *Ann. der. Physik*, **2**, 274.

Wont J. J. 1951 *Physica*, **17**, 98.

Yamamato M. & Miyaswa R. 1953 *Sci. Repts. Thoku. Univ.*, **A5**, 22.