Pramāṇa – J. Phys., Vol. 28, No. 3, March 1987, pp. 277–285. © Printed in India.

Effects of various ambient-aging processes in chopped and non-chopped optical films

K VIJAYA, R K PURI and R N KAREKAR
Department of Physics, University of Poona, Pune 411 007, India

MS received 4 April 1985; revised 29 December 1986

Abstract. The effects of various ambients on the non-chopped and chopped films of cryolite, MgF_2 and mixed cryolite-MgF_2, as measured by ellipsometer, are reported. The moisture decreases the refractive index whereas an increase is observed in air and other ambients. In all the ambient-aging the chopped films show smaller changes (nearly half) in refractive index than non-chopped films. Aging seems to be due to three main processes, a long-term adsorption-like surface reaction and two short-term reactions.

Keywords. Optical films; aging; chopped films.

PACS Nos 78·65; 78·20; 68·55; 42·78

1. Introduction

Many workers (Holm and Christensen 1980; Kinoshita and Nishibori 1969; Koch 1965; Koppelmann *et al* 1961; Macleod 1976; Ogura *et al* 1975, 1976; Pulkar 1971) who studied the problem of aging of optical films have found it difficult to provide a solution to the problem on a generalized level. We had earlier reported a new technique of chopping the vapour stream during deposition which reduces the aging of the films in air (Vijaya *et al* 1980). In this paper we report further studies on chopped films.

2. Experimental

The films, both non-chopped and chopped (5–6 rot/sec) of cryolite, MgF_2 and mixed cryolite-MgF_2 obtained (Vijaya *et al* 1980) by vacuum evaporation (vacuum 2×10^{-5} torr, deposition rate 15 Å/sec) were subjected, for few hours (short term aging), to different ambients: (a) air at room temperature, (b) gaseous environment (O_2 and CO_2 separately) for 21 hr, (c) heat to 120°C in air for 3 hr (heat), (d) steam for 3 hr at a flow rate of 0·23 ml/sec along with heating of substrate to 120°C to avoid condensation, (e) saturated humid atmosphere at three temperatures: (1) 12°C low temperature (LTM), (2) 27°C room temperature (RTM), (3) 55°C high temperature (HTM), each for 3 hr.

The effect of repeated (i) RTM exposures (for few hours, but totalling upto about 150 hr) and (ii) RTM heat cycling few hours each, was further studied in greater detail (Vijaya 1982).