International Journal of Advance Research in Science and Engineering
Volume No.07, Special Issue No. (02), January 2018
www.ijarse.com
IJARSE
ISSN: 2319-8354

Theory of Mechanoluminescence of coloured alkali halide crystals using pressure steps

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ABSTRACT

The theoretical approach to the ML induced by the application of loads on coloured alkali halide crystals. It is shown that the time-constant for the rise of pressure and the pinning time of dislocations and the work hardening exponent can be determined from the measurement of the time dependence of ML and the pressure dependence of ML.

Keywords: Mechanoluminescence, Dislocation, coloured alkali halide crystals

I. INTRODUCTION

Most of the studies on the ML have been made either during slow deformation of the crystals or during fracture of the crystals. Only limited studies have been made on the ML induced during the application of loads on the crystals. Preliminary report of the ML emission during application of pressure on coloured alkali halide crystals were given by Urbach (1930) and Trink (1938). Kyuglov *et al.* (1966) have made a systematic study of the luminescence produced by plastic deformation of γ-irradiated KCl crystals from a stress lower than the elastic limit up to the breakdown stress of the crystals. They have reported that the luminescence of γ-irradiated KCl crystals induced by plastic deformation occurs during loading from a stress lower than the elastic limit to the breakdown stress of the crystal. A similarity between the stress-strain curve and the load luminescence curve is established. A luminescence yield stress of the irradiated crystals can be determined from the load-luminescence curves. Studies on slip band formation, pre-irradiation treatment of the crystals, and the effect of rate of load application have been presented. Qualitative information about the nature of the luminescence produced during the deformation is given. A tentative model of the luminescence phenomenon from the start of the elastic deformation upto the stress under which the crystals is heavily deformed has been reported. The model is based on the fact that the region around dislocations contains a higher concentration of colour centres than the average concentration in the bulk. The instability introduced to the regions of high concentration of colour centres produces a considerable amount of luminescence spikes in the luminescence produced at high stresses are due to the formation of slip bands.