CHAPTER-I

INTRODUCTION

In one of the research laboratories of U.S.A., young research workers were recording the spectrum of different chemicals by using them in the arc of a 120 cell Bunsen Battery. Unfortunately, next day, their eyes smarted and different parts of their bodies which were directly exposed to the arc developed redness. They thought that, it might be the adverse effect of the exposure of human body to the chemical rays emanated from the arc. However, the problem remained unresolved for more than twenty years. With increasing demands in the useful applications of UV radiation, the health physicists, engineers and research workers used the UV radiation for medical treatment, production of vitamin D, disinfection of air, water and other liquids, fluorescent lamp and printing etc. They also experienced the above mentioned adverse effect due to exposure of UV light to different parts of their bodies. The World Health and Safety Research workers undertook this problem and investigated that the skin reddening (Erythema) and inflammation of the cornea and of the conjunctiva (Kerotoconjunctivities) are found due to the effects of the exposure to UV radiation. Most of the UV radiation sources used by medical and industrial people for different applications cover actinic (200 - 320 nm) as well as the near UV wavelength (320 - 400 nm) regions. In 1974, the American conference of Governmental Industrial Hygieneists[1] standardized the fact that Erythema and Burns of the skin (probably skin cancer) are produced mainly by UV radiation of wavelength less than 320 nm ($\lambda < 320$ nm). The smallest amount of UV energy that produces barely visible reddening of the skin at particular wavelength of interest is referred the Minimum Erythemal Dose (MED). For example, the MED value is 3×10^2 Jm^{-2} for 296.7 nm radiation[2]. The dermatologists and skin photobiologists need a dosimeter of UV radiation in sunburn range (i.e. $\lambda < 320$ nm). Thus, the professional workers require the accurate knowledge of the radiant exposure of UV radiation for its appropriate applications and to decide the precautionary measures for protection of the skin and eyes against the acute effect of erythema and Keratoconjunctivities.

Looking to the importance of the radiant exposure to UV dose in practical life, various techniques and instruments have been developed for its estimation[3-5]. Health physicists, from their experiences, have found the UV dosimetry using TL technique, the best amongst them, on account of the following reasons :

1) small size of dosimeter.
2) suitable for "in vivo" studies (eg. skin transmission) and personnel dosimetry.

3) non-requirement of electronic instruments at site of measurement and unattended operation.

and 4) very quick in offering final result.

The essence of the method is that a small quantity of thermoluminescent (TL) material is placed at region of interest, that there the TL material absorbs and retains some energy in its interaction with the UV radiation field and that some of the absorbed energy can be released later as visible and near visible light when the TL material is subsequently removed and heated with uniform heating rate. A measurement of the light emitted can serve as a measure of absorbed dose in the UV radiation field.

The TLD method depends for its application on the existence of suitable TL materials. To be practical a TL material should be reliable, sensitive, non-toxic, convenient to use and inexpensive. Ideally, a variety of TL material should be available, with different dosimetric properties, so that biological tissues (and other materials) of different absorptive properties could be closely matched.

TL phosphors succesfully used in the estimation of gamma, beta,neutron and X - ray doses were found unsuitable in UV dosimetry on account of their poor intrinsic TL on UV irradiation. However, several TL phosphors like LiF:Mg:Ti[6], $CaSO_4:T_m$[7] and natural CaF_2[8] have been made sensitive to UV radiation on pre-irradiation with high doses of gamma radiation and subsequent partial annealing. The preparation method of TLD material and the TL transfer process are complex and time consuming. The resulting TL-output is also related to the pre-treatment. These limit the wide use of such phosphors in solid state UV dosimetry. Recently, a few TL phosphor which respond directly to the UV stimulation have been reported, thereby making TL - UV dosimetry simple and practicable.[2,9-11] In their experiments, they gave pre-annealing treatments around 500°C for an hour in air to different TL phosphors (all in lose powder form) obtained from different manufacturing companies. These materials were referred as "virgin phosphors" and their direct TL response to UV radiation was designated as "INTRINSIC" response. In order to select a TLD material having the highest intrinsic TL sensitivity to UV irradiation, they compared intrinsic TL sensitivities of all common TLD phosphors, including LiF TLD - 100, to UV radiation of wavelength 253.7 nm. In their study $Mg SiO_4$:Tb was found to have the highest sensitivity and hence it was strongly recommended for TL-UV dosimetry.

Recently, pure sodium chloride and Ca doped NaCl have been reported to be useful in gamma dosimetry.[12,13] This initiated the author to explore in detail the use of

NaCl:Ca phosphor as UV-TL dosimetry material. The use of intrinsic TL of NaCl:Ca in UV dosimetry has not been systematically investigated before. The main purpose of the present work is to examine the intrinsic TL characteristics of NaCl:Ca and to study the dosimetric properties of a selected well defined glow peak in the material and thereby develope a practical system of UV-TL dosimetry using NaCl:Ca. The TL behaviours of UV irradiated NaCl:Ca prepared under different physical situations have been examined and an attempt is made to propose the TL centres and the mechanisms responsible for the occurrence of various observed glow peaks.