A B S T R A C T

ABSTRACT

The present work reports detailed systematic optical study of chemical and thermal etching and of micro-indentation hardness on rhombohedral cleavage surfaces of natural calcite crystals obtained from different localities in India. In addition to this, it presents an optical study of dehydration figures of selenite crystals containing water molecules. For the purpose of lucid presentation, the thesis is divided into five parts. A brief description of each of these parts is given below.

The first part presents general information on calcite and a brief description of the high resolution optical techniques and other methods used in the present investigation such as (i) high resolution optical microscopy including light profile microscopy and multiple beam interferometry, (ii) silvering technique and (iii) etch method.

The second part presents observations on some typical aspects of chemical etching of calcite cleavages.

Inspite of a large number of research papers on etch phenomena on crystal surfaces it is found that the theory of etching is not yet well formulated. There are several questions which are not yet fully answered; such as the origin of etch pits, symmetrical and asymmetrical aspects of etch pits, variation of shape and orientation of etch pits with change of concentration of etchant, with change of etching time, with change of temperature, with change of composition of etchant or with rate of stirring of etchant (containing crystal) or with simultaneous change of all these factors. An attempt is made in this part to provide, answers to some of these questions. In the study of etching of calcite cleavages, several etchants were used such as solutions of strong alkalies (e.g. NaOH, KOH), solutions of salts (e.g. NH_4Cl etc.), solutions of inorganic acids such as HCl, H_2SO_4, HNO_3 with various concentrations in distilled water, solution of organic acids such as acetic acid, tartaric acid with various concentrations in distilled water. Amongst all these etchants, the effects of two etchants viz., hydrochloric acid (A.R. quality) and glacial acetic acid of various concentrations on cleavage surfaces of calcite were studied in detail.

Asymmetrical nature of a pit produced by an etchant is measured by its eccentricity which found to be a function of concentration and composition of the etchant, conditions of etching, time of etching and temperature. The first two factors are rigorously studied in the present investigation. By using a range of concentrations of etchant with other factors constant, various shapes of etch pits are observed on the calcite cleavages. The study of matched faces etched by etchants of different concentrations showed very clearly that inspite of a change in the shape of the etch pits at corresponding positions on the cleavage faces, the number and positions of pits remain unchanged (Chapter IV). Similarity between static and dynamic etching of the cleavage surfaces by these etchants is traced and discussed (Chapter V). This is followed by a study of eccentric pits on calcite cleavages. The implications of all these observations are discussed in this part.

The third part presents a general introduction on thermal etching (Chapter VII) of crystals and a systematic detailed study of thermal etching of calcite cleavages (Chapter VIII). Unlike thermal etching of other crystals, the thermal etching of calcite has the peculiarity that it can be effected only within a small

range of temperature. The thermal etch pit geometry and other etch features are discussed and compared with those obtained by chemical etching. There is a significant divergence between the density of chemical pits and thermal pits on matched cleavage surfaces.

The part fourth reports general features of dehydration. It is followed by a detailed discussion of the dehydration figures of crystals containing water molecules, such as gypsum etc. A detailed study of the dehydration figures and the etch figures produced by chemical etching on matched cleavage faces is then presented.

The fifth part gives general information on hardness and deals with the optical study of micro-indentation hardness of cleavage surfaces of calcite. A short description of Vickers hardness indenter employed in the study of hardness is given. Detailed systematic study of various features such as effect of load on hardness, texture of cleavage surfaces produced by different methods, orientation effect, is presented in this part along with the conclusions.

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