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OPTICAL OBSERVATIONS OF THE f.c.c. → s.c. TRANSFORMATION IN SINGLE CRYSTALS OF RbI AT HIGH PRESSURES

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Abstract—The transformation of rubidium iodide from its low pressure sodium chloride structure to its high pressure cesium chloride structure takes place at a pressure of about 3500 b. This transformation has been studied optically in single crystals, using a high pressure vessel with sapphire windows, a modified Vickers metallographic microscope and time lapse photographic techniques. The transformation behavior of the crystal depends sensitively on the condition of its *surface*. Freshly cleaved crystals or crystals which have been etched in RbI solution transform in two stages. Firstly, the transformation proceeds from a *few* surface sites and spreads over the entire *surface* of the crystal, then the *interior* of the crystal transforms. We hypothesize that the first stage of surface transformation reflects a condition of relative compression of the surface layers of the NaCl structured phase of RbI compared with the interior with the consequence that the surface layers transform at a lower value of applied pressure than does the interior. In cleavage crystals which have been stored under oil for a long time prior to observation, the surface transformation is absent and the pressure at which observable transformation occurs is much higher, in agreement with optical observations by other investigators.

The equilibrium pressure between the two phases has been found to lie in the range 3430–3650 b at room temperature, somewhat lower than the range 3500–3900 b previously established by Bridgman's measurements.

INTRODUCTION

THE alkali halides are known to crystallize in either the f.c.c. NaCl structure or the simple cubic CsCl structure. Polymorphism between the structures occurs in many of the cases. For instance, CsCl transforms at high temperatures to the f.c.c. phase and transformations at high pressures discovered by SLATER,[1] BRIDGMAN[2] and PIERMARINI and WEIR[3] in potassium and rubidium halides have been established by high pressure X-ray methods to be to the simple cubic CsCl structure.[3–9]

The alkali halides constitute one of the simplest and best understood systems of solids i.e. they have a simple structure, their cohesive energy is accounted for in a relatively simple way, and their behavior is not complicated by the presence of conduction electrons as is the case in even the simplest polymorphic metals, lithium and sodium. It might be expected that any study of their transformation properties will provide information useful to the theory of polymorphic phase transformations. Rubidium iodide was chosen as the object of this study because at room temperature the transformation occurs at an easily accessible pressure of less than 4000 b.

Several accounts in the literature[10,11] describe the effect of the transformation process on transmission of light through the crystal. In JACOB's[10] optical observation of RbCl, the transformation took place at pressures much higher than values established by Bridgman as the equilibrium pressure for the transformation. Our experiments were carried out using single crystals with the goal of making systematic microscopic optical observations on the transforming material, and of obtaining an

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