900° C, the crystals of $ThSiO_4$ are scarcely produced.

Table I shows the preparation conditions. When uranium dioxide co-exists with ThO_2 in the hot zone, the crystals of $ThSiO_4$ produced become green and transparent. Even in these cases the lattice constants of $ThSiO_4$ do not vary, so that the solubility of uranium in $ThSiO_4$ is deduced to be so small as to be only a degree of order of doping. Fig. 1 shows a crystal of $ThSiO_4$ doped with uranium which is green in colour. The lattice parameters of the $ThSiO_4$ produced were $a_0 = 7.090 \pm 0.004$ Å and $c_0 = 6.317 \pm 0.004$ Å

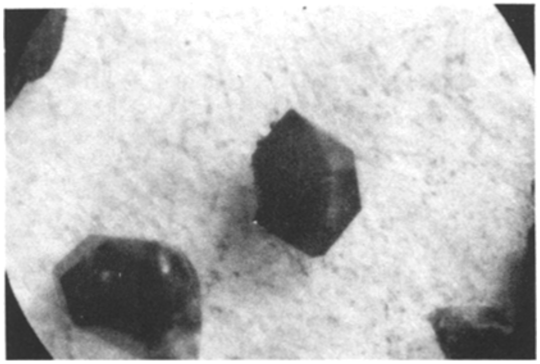

Figure 1 $ThSiO_4$ crystals doped with uranium (green in colour). Maximum length is about 1 mm.

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The morphology of single crystals during compressive creep testing

Several investigators [1–3] reported that the change in morphology of single crystals undergoing compressive creep is a function of the loading system and that the shape of the creep curve is related to the morphology. Although their analyses were based on observations made on specimens at the completion of the creep test, the observations suggested that the type of morphology was directly related to the various stages of creep, i.e. primary, steady-state, etc. The present study was conducted to record the morphology changes of a specimen during a compressive creep test.

Time lapse photography was used to observe and record pictorially the specimen morphology as it deformed. After placing the specimen in the furnace, the telescope and camera were aligned so that the specimen could be clearly seen through the viewfinder of the camera. Focusing was done at room temperature by adjusting the objective lens of the telescope and the camera's focusing ring. At the temperatures (1000° C to 1300° C) employed during these experiments, the interior of the furnace essentially became a black body, making it impossible to distinguish the specimen from the background of the furnace. A blue glass filter was used to eliminate most of the light radiated by the hot furnace. To provide the contrast required for photography, a high intensity white light source of at least 300 W was used to illuminate the specimen. The blue filter, although filtering out most of the light created by the high temperature conditions, would allow enough light to pass through to enable the image of the specimen to be recorded. A Kodak Cine-Special 16 mm movie camera with double X negative film was used to record the specimen morphology. Generally, 12 frames per minute were exposed during the experiment.

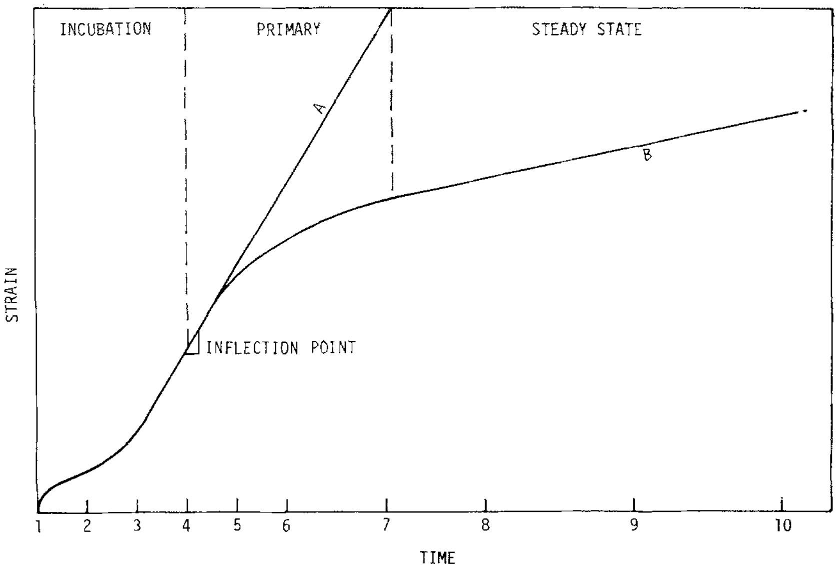

Figure 1 Creep curve under two different experimental conditions: Curve A, unconstrained; Curve B, constrained.

Several $(Co_{1-x}Ni_x)O$ single crystal specimens were deformed in compression and their morphology changes recorded by the time lapse photography method described above. Discussion of the specimens and creep experiment procedures are described elsewhere [4].

Fig. 1 illustrates the strain time curves for two different experimental conditions: (a) Curve A, the specimen ends were free to move laterally as it deformed; and (b) Curve B, the specimen ends were constrained as it deformed. When the experimental conditions are such that the specimen never reaches the primary stage of creep, the post creep morphology has been shown [1–3] to be similar to the photographs in Fig. 2 corresponding to Curve A. Fig. 2 shows the macrostructure for both constrained and unconstrained specimens at the time intervals marked on the curves in Fig. 1. The photographs in Fig. 2 were made from the time lapse movies described above. The face of the specimen in Fig. 2 is the (1 0 0) plane, parallel to the [0 0 1] stress axis.

It is evident from Fig. 2 that slip occurs along one plane (initial plane) in the {1 1 0} ⟨1 1 0⟩ slip system through incubation up to the inflection point and is independent of experimental conditions (unconstrained or constrained). The specimen moves into primary creep when slip begins on the orthogonal plane, causing barrelling. It is difficult to tell from the movies and/or Fig. 2

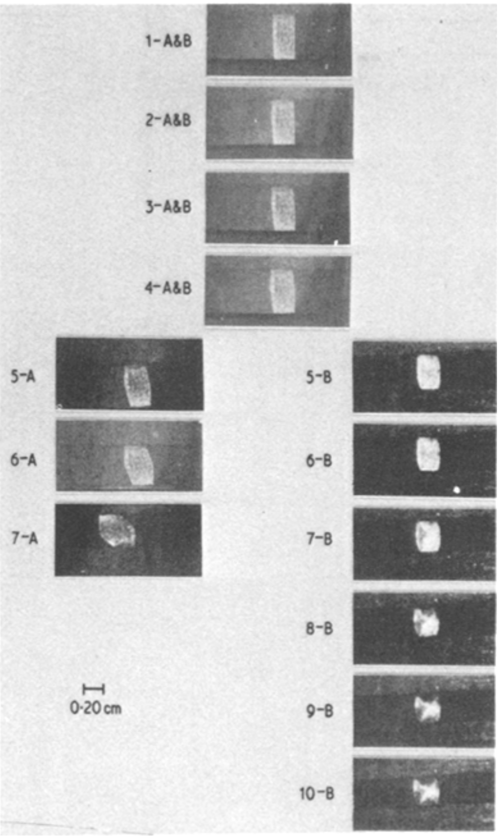

Figure 2 Typical morphology for unconstrained (A) and constrained (B) specimens. Numbers correspond to the time intervals shown in Fig. 1. Photographs 1 to 4 are for both unconstrained and constrained conditions.

whether slip ceases completely on the initial plane as the orthogonal plane begins slip or if slip continues at a slower rate on the initial plane. It appears from studying the films that slip at a slower rate on the initial plane until the specimen has deformed by an equal amount along the orthogonal plane. At this point, the specimen has reached steady-state creep where slip occurs along both the initial and orthogonal planes at equal rates as evidenced by equal barrelling.

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