Lattice Parameters of InN in the 22-310 K Temperature Range

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Thin layers formed from III-V nitrides (AlN, GaN and InN, wurtzite structure type) and their solid solutions are components of optoelectronic devices. The structural and thermal-expansion data on the bulk material are essential in the design of such devices. Variation of unit-cell size of indium nitride with temperature has been studied in Refs. [1-3]. The low-temperature range has been only partially explored up to now. Previous studies involved the $a(T)$ and $c(T)$ runs in a broad T range, measured at a laboratory equipment [1], evaluations through a pseudoempirical model [3], and experimental determination of the lattice parameters $a(T)$ and $c(T)$ from 105 K to room temperature from synchrotron data [2]. Among the experimental data, those below 105 K were poorly known, whereas those above 105 K and room temperature required a more detailed study.

In the present study, the structural information on indium nitride is obtained from powder diffraction patterns in an extended temperature range. Polycrystalline indium nitride powder studied in this paper was prepared at Warsaw University of Technology from high-purity components by reaction of indium metal with urea [4]. Phase analysis shows that a minor-impurity phase in InN is indium oxide with relative intensities of the strongest diffraction peaks at the level of about 2%.

Low temperature studies were performed at a synchrotron radiation source (B2 Hasylab beamline) in the temperature range from 22 K up to 310 K using the instrumentation described in Ref. [5] including a closed-cycle He cryostat. An image-plate detector was applied for data collection. The systematic errors were removed using the internal diamond standard, according to the method described in Ref. [6]. The lattice parameters were determined with the use of the Rietveld method using the Fullprof program.

The lattice parameters a and c behave in a similar way. Below about 130 K they vary marginally (Figure 1). In the range 200 to 300 K the temperature dependencies are close to linear ones. Temperature variations of refined lattice parameters are consistent with earlier literature data but they exhibit a markedly lower scatter. According to the present result, the axial ratio for InN is virtually constant, $c/a = 1.61295(5)$, in the studied temperature range.

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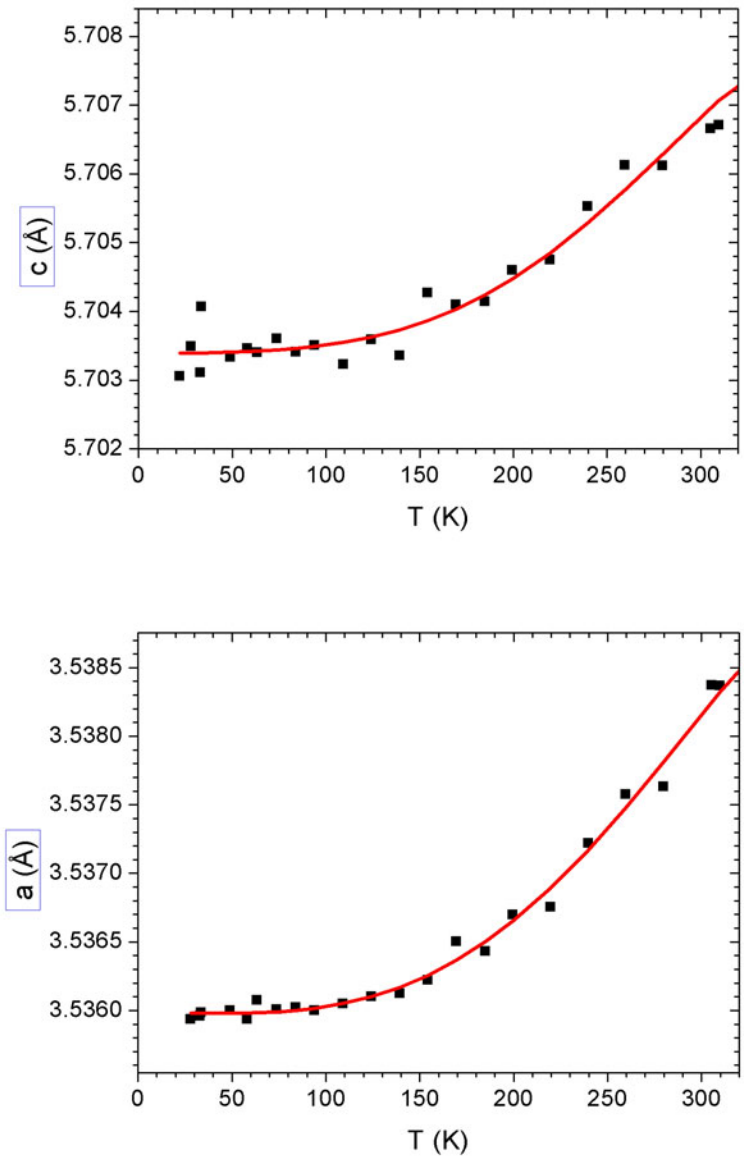

Figure 1: Lattice parameters *a* and *c* of InN as a function of temperature.

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