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ESRF

Experiment Report Form

The double page inside this form is to be filled in by all users or groups of users who have had access to beam time for measurements at the ESRF.

Once completed, the report should be submitted electronically to the User Office using the **Electronic Report Submission Application:**

http://193.49.43.2:8080/smis/servlet/UserUtils?start

Reports supporting requests for additional beam time

Reports can now be submitted independently of new proposals – it is necessary simply to indicate the number of the report(s) supporting a new proposal on the proposal form.

The Review Committees reserve the right to reject new proposals from groups who have not reported on the use of beam time allocated previously.

Reports on experiments relating to long term projects

Proposers awarded beam time for a long term project are required to submit an interim report at the end of each year, irrespective of the number of shifts of beam time they have used.

Published papers

All users must give proper credit to ESRF staff members and proper mention to ESRF facilities which were essential for the results described in any ensuing publication. Further, they are obliged to send to the Joint ESRF/ ILL library the complete reference and the abstract of all papers appearing in print, and resulting from the use of the ESRF.

Should you wish to make more general comments on the experiment, please note them on the User Evaluation Form, and send both the Report and the Evaluation Form to the User Office.

Deadlines for submission of Experimental Reports

- 1st March for experiments carried out up until June of the previous year;
- 1st September for experiments carried out up until January of the same year.

Instructions for preparing your Report

- fill in a separate form for each project or series of measurements.
- type your report, in English.
- include the reference number of the proposal to which the report refers.
- make sure that the text, tables and figures fit into the space available.
- if your work is published or is in press, you may prefer to paste in the abstract, and add full reference details. If the abstract is in a language other than English, please include an English translation.

ESRF	**Experiment title: Determination of the local structure of amorphous InSe films by EXAFS**	**Experiment number**: HS-1108
Beamline: BM32	**Date of experiment**: from: 20/07/2000 to: 25/07/2000	**Date of report**: 27/02/2001
Shifts: 9	**Local contact(s)**: Dr. David LeBolloch	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

A. Mosset, Laboratoire de Cristallographie, CNRS, Grenoble, France,

D. Raoux, Laboratoire de Cristallographie, CNRS, Grenoble, France,

A. Burian*, University of Silesia, Katowice, Poland,

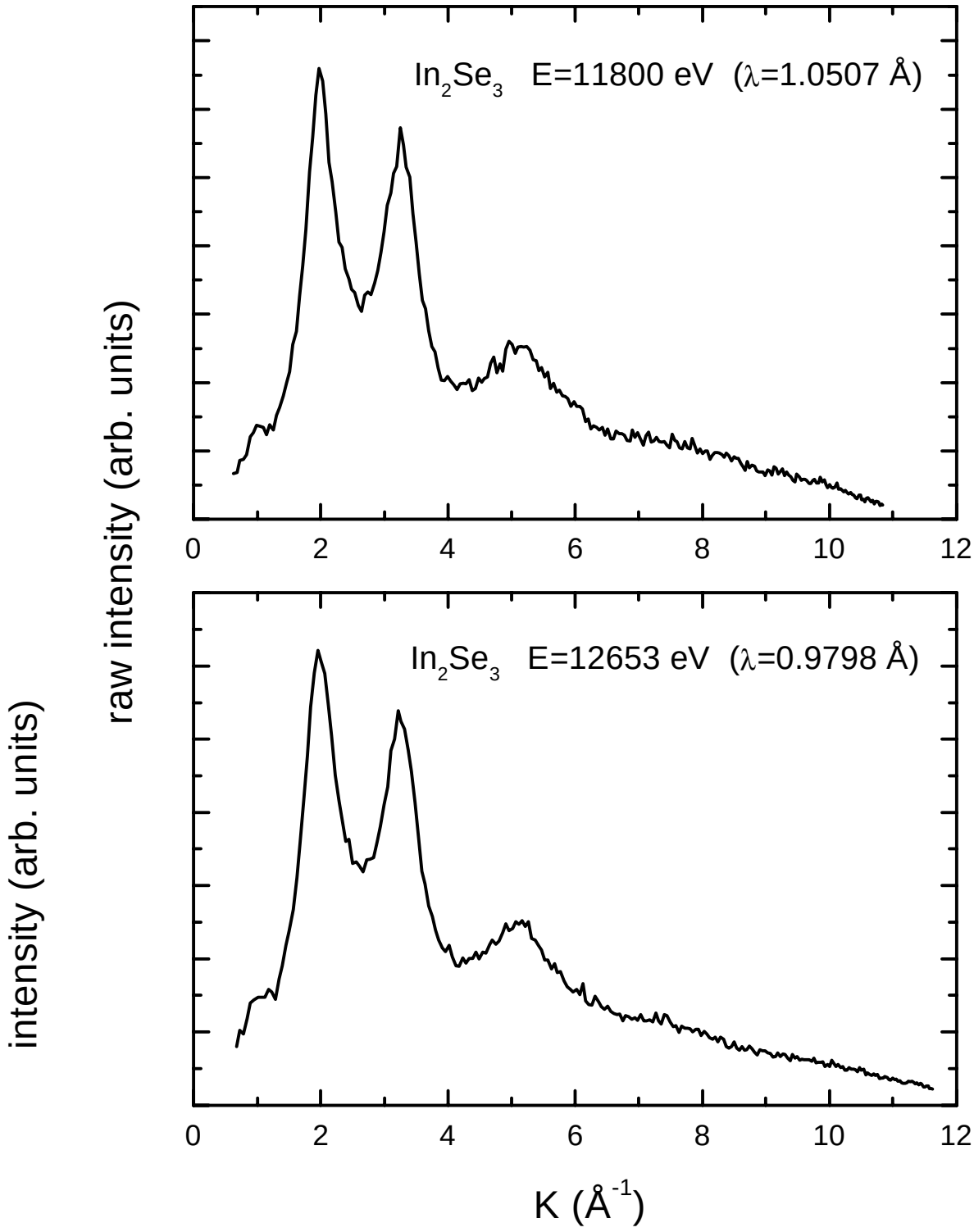
A. Jablonska*, University of Silesia, Katowice, Poland,

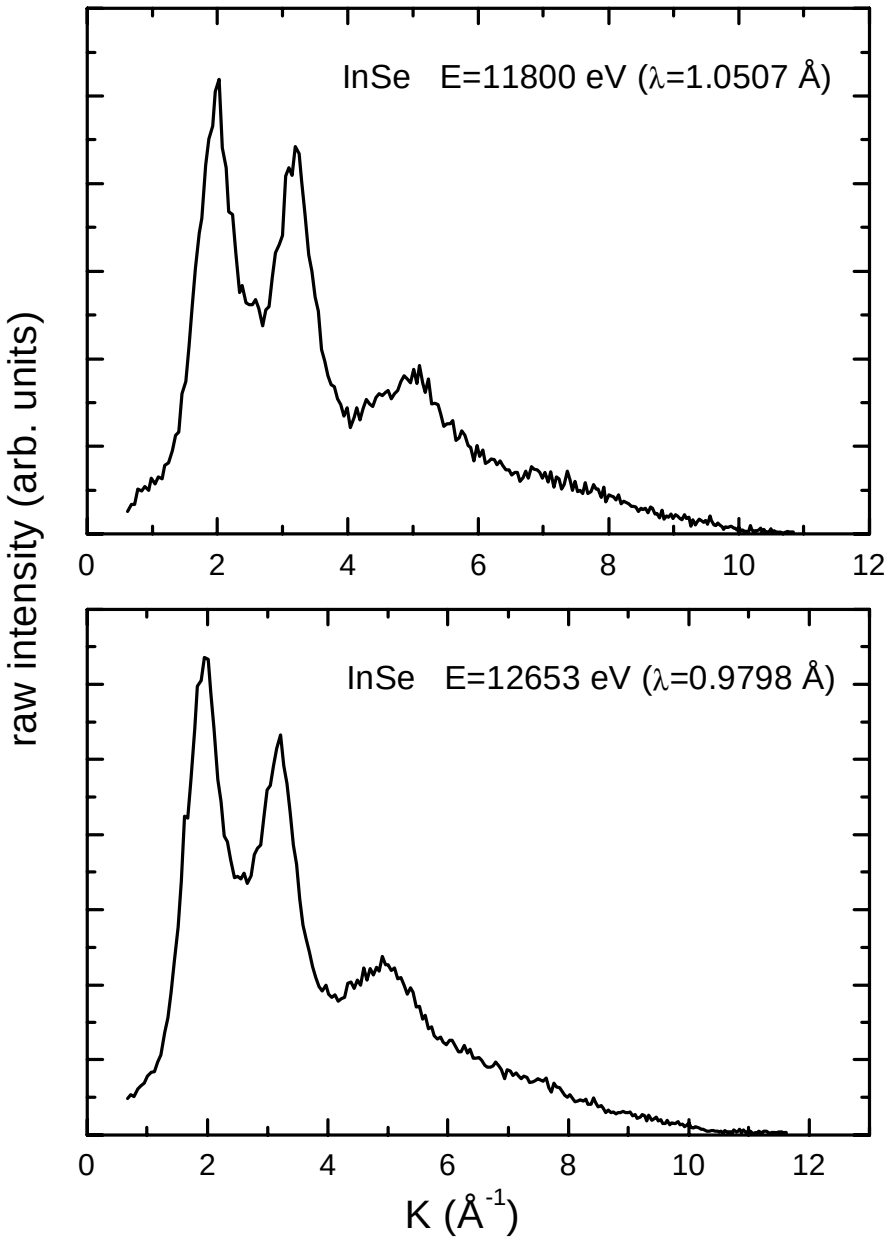
Report:

Semiconducting amorphous In-Se films, produced by thermal evaporation in vacuum, containing 50, 60 and 66 at.% Se have been studied by Se K-edge X-ray absorption fine structure (EXAFS). The deposition was carried out at a pressure of 10 mPa. The final thicknesses of 40-50 μm were achieved after series (usually about 10) of 5-min. evaporation runs. Compositional analysis performed by the microprobe and XPS methods showed that the composition of the investigated films are exactly the same as the source materials due to a high deposition rate, not less than 15 nm/s. The most important characteristic of these compounds is that they form strong covalent bonds within layer and have weak interlayer interaction of the Van der Waals type. In thin film form, both crystalline and amorphous, indium selenide compounds have suitable electrical and optical properties for applications as solar cells and switching elements for memory applications. The layered structure of the In-Se films make them attractive material for intercalation and a potential application in lithium batteries. Owing to the layered structure a low density of dangling bonds is expected which makes it possible to produce heterojunction devices with a low interface density of states.

Two component amorphous semiconductors have become of interest because of possibilities for applications and contribution to understanding transport and optical properties of non-crystalline systems. The structural disorder, either configurational or chemical, is the basic factor which determines fundamental properties of non-crystalline semiconductors, i.e., their electrical and optical characteristics. Configurational

disorder refers to fluctuations in both bond lengths and valence angles. Chemical disorder relates to bonding arrangement in which the minority component is coordinated by atoms of both kinds. For amorphous semiconductors the energy structure, resulting from the splitting of the bond or lone pair and anti-bonding states, is influenced by disorder. Namely, the abrupt band edges of a crystal are replaced by broadened tails od states originating from configurational disorder. This kind of disorder causes electron localisation and strong electron scattering. Coordination defects, dangling bonds and chemical disorder lead to the occurrence of electron states deep within the band gap. The structural information about configurational and chemical disorder can be obtained from anomalous X-ray scattering experiment. This technique utilises the abrupt changes in the atomic scattering factors of components near their absorption edges and allows to determine the partial structure factors and the partial radial distribution functions [A. Burian, J. Non-Cryst. Solids, (1998) **223**, 91]. The anomalous X-ray data were collected at ESRF on the ID01 beam line using incident photon energies exactly at the Se absorption edge (12653 eV) and below the edge (11800 eV). The resulting intensities are shown as a function of the scattering vector $4\pi\sin\theta/\lambda$ in attached figures. The main advantage of the use of third generation synchrotron radiation source is that it is possible to measure a pure diffraction profile even at the energy of the edge. Excitated fluorescence, the Compton and Raman scattering were eliminated by an InSb analyser mounted before the detector. Extremely high photon flux allows to use such an experimental set up. This makes the data processing much simpler and the correction procedure is limited only to the absorption correction. The obtained data will be used to determine the partial structure factors after completing the anomalous scattering and the EXAFS data at the In K-edge.


In2Se3 E=11800 eV (λ=1.0507 Å)
In2Se3 E=12653 eV (λ=0.9798 Å)
raw intensity (arb. units)
intensity (arb. units)
0
2
4
6
8
10
12
K (Å-1)


InSe E=11800 eV (λ=1.0507 Å)
InSe E=12653 eV (λ=0.9798 Å)
raw intensity (arb. units)
0
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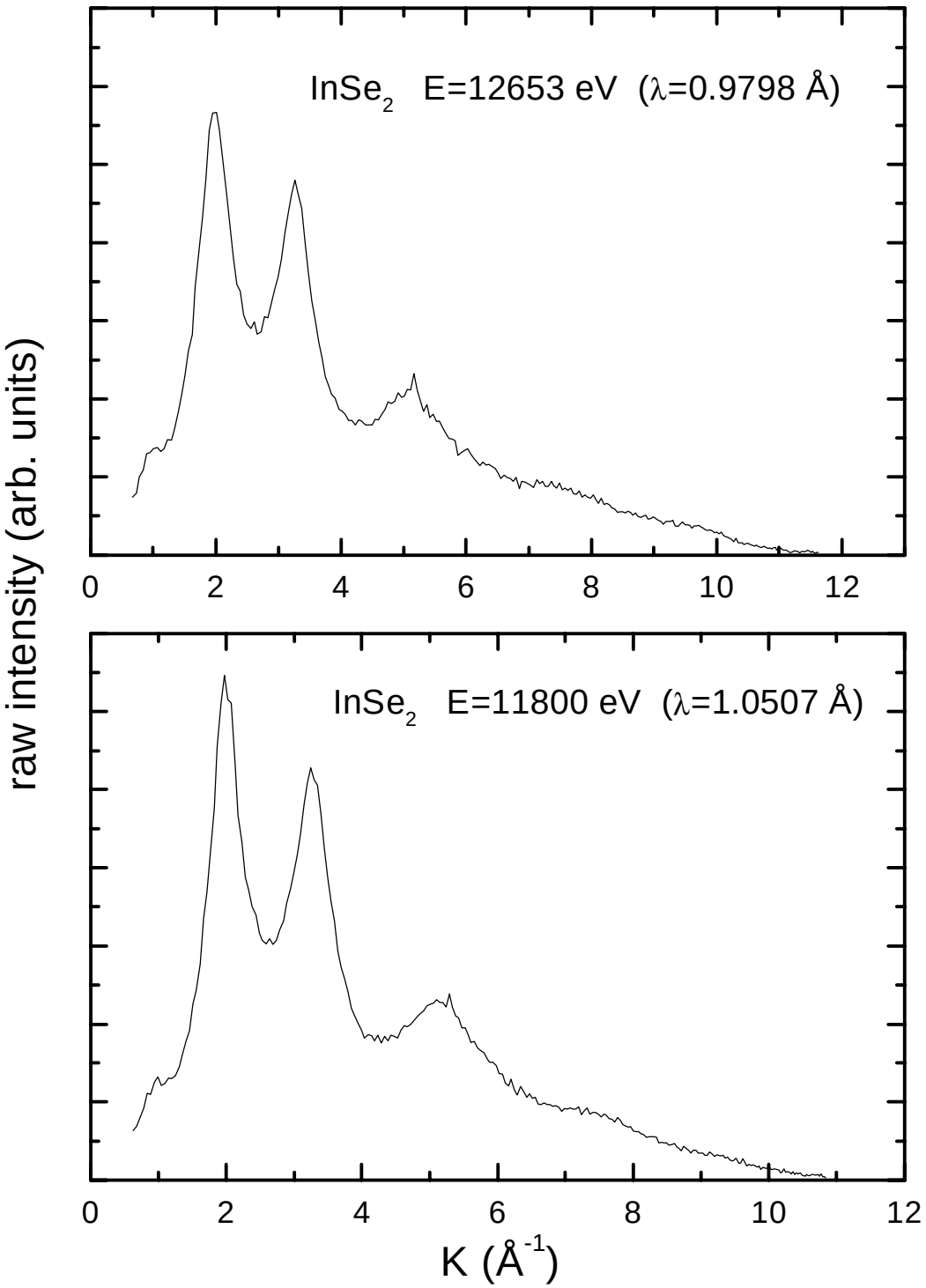
K (Å-1)


InSe2 E=12653 eV (λ=0.9798 Å)
InSe2 E=11800 eV (λ=1.0507 Å)
raw intensity (arb. units)
0
2
4
6
8
10
12
K (Å-1)