

Pnictide and chalcogenide semiconductors

Andriy Zhugayevych

March 15, 2011

Contents

1	Introduction	1
2	General properties of amorphous semiconductors	2
2.1	Negative-U scenario in EHP model	3
2.2	Negative-U scenario of Anderson	4
2.3	Negative-U scenario of Street and Mott	5
2.4	Polaron theory of Emin	5
3	Elemental pnictogens	5
4	Elemental chalcogens	6
5	Pnictogen chalcogenides	6
5.1	Atomic structure	6
5.2	Electronic properties	8
5.3	Models of electronic structure	8
5.4	Defect centers	9
5.5	Liquid chalcogenides	11
5.6	Photoinduced phenomena	11
5.7	Electrically induced phenomena	12
5.8	Pressure-induced phenomena	12
5.9	Related properties of conducting polymers	12
6	IV+VI chalcogenides	13
7	Application of chalcogenides	13
A	Atomic data	14

1 Introduction

An excellent handbook-style review on chalcogenides can be found in [1]. Other useful and up-to-date resources on chalcogenides include collection of papers [2], general reviews [3, 4] and monographs [5, 6], specialized journal *Chalcogenide Letters* and Web-page [7]. Despite the long history of persistent studies, the entire picture of the physics of chalcogenides is far from completeness, consistency, and concordance. The reason of this is twofold. On the one side, chalcogenides exist in various forms from bulk and molecular crystals to glasses and amorphous films accepting various nonstoichiometric compositions. Moreover, for a specific substance like g-As₂Se₃ observed phenomena are also sample dependent: often different authors obtain different results. At the same time many physical phenomena are common for all chalcogenides, so that one may think to find some “universal theory”. But this way looks fallacious since for many phenomena their opposite counterpart is also observed, e.g. photocrystallization and photoamorphization processes, that leads sometimes to ridiculous situation when different authors use the same deduction line and come to opposite phenomena. Therefore from the view of the above facts experimental studies of chalcogenides should be done under precise knowledge of what substance is under investigation and a theoretical analysis of existing experiments should be done with taking into account all the