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SEMI-INSULATING TRANSITION METAL-DOPED III–V MATERIALS

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This review surveys the properties of transition metal (TM) doped semi-insulating (SI) III–V semiconductors. After a general definition of a SI material, a simple model of a SI crystal with a midgap donor and shallow impurities is discussed. A short history, main properties, and thermal stability problems of SI Cr-doped GaAs are presented. The puzzling problem of SI V-doped GaAs is explained. Several dopants (Cr, Fe, Co, and Ti) in SI InP are discussed in terms of the resistivities obtained, as well as thermal stability. Finally, GaP and GaInAs high resistivity systems are considered.

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1. Introduction

Transition metal (TM) impurities in III–V compounds have been investigated for a quarter of a century. These omnipresent, multicharge, and multilevel deep centers, acting as donors, acceptors and sometimes double acceptors, have very significant impact on optical, transport, magnetic, and other properties of III–V semiconductors. Several review articles have recently been devoted to this subject (see, for example, [1-4]).

The first, and still the most important, application of transition metals impurities in III–V compounds is their ability to compensate shallow impurities and thus produce semi-insulating (SI) materials.

The term semi-insulating material has been used for many years, being introduced into the *Physics Abstracts* in 1969. However, in the late seventies, their importance has grown seriously, and since 1980, a series of conferences devoted exclusively to SI III–V materials has been organized [5-9]. The sixth of these will take place three weeks from now, in Toronto.