

Preface

This volume of Diffusion Foundations is devoted to high-tech materials such as elemental and compound semiconductors (chapters 1 and 2) and high-entropy alloys (Chapters 3 and 4). In addition one chapter considers thin-film devices, which are important in surface- and nanostructure-based technologies (chapter 3). Thin silicide and germanide films are used as ohmic contacts in microelectronics.

Chapter 1 by H. Mehrer deals with '***Diffusion and Point Defects in Elemental Semiconductors***'. Elemental semiconductors are important for high-technological equipment used in industry and everyday life. Diffusion in silicon and germanium is a key process in the fabrication of semiconductor devices. Silicon plays a dominant role in the fabrication of solid-state electronic devices (memory chips, processors chips, ...) for computers, tablets, and smartphones. Silicon is also important for photovoltaic devices of energy production. Germanium is used in special areas, such as for X-ray detectors, infrared lenses, and infrared windows.

Chapter 2 by W. Jäger describes '***Diffusion and Defect Phenomena in III-V Semiconductors and their Investigation by Transmission Electron Microscopy***'. This chapter reviews studies of diffusion and defect phenomena induced by zinc diffusion in the single-crystal III-V compound semiconductors GaAs, GaP, GaSb and InP by methods of transmission electron microscopy. Consequences of defect phenomena for the modelling of Zn (and Cd) diffusion concentration profiles are also discussed. Dopant diffusion in III-V semiconductors is an essential processing step in the fabrication of optoelectronic devices, such as high-frequency devices for mobile communication, lasers, light emitting diodes, and detectors. Frequently used doping elements, for instance in GaAs-based device applications, are zinc and beryllium for p-doping and silicon for n-doping.

Chapter 3 by A. Portavoce and K. Hoummada is devoted to the '***Role of Atomic Transport Kinetics on Nano-film Solid-state Growth***'. Fabrication of thin films plays an key role in surface technologies, as well as in nanostructure-based technologies (nano-technology). Thin films are often used to modify mechanical or chemical properties of surfaces for life-time improvement of mechanical parts or for corrosion protection. Thin films in some cases are formed by atomic diffusion or reaction, usually providing a stronger interface with the covered material. Chapter 3 focuses on nano-films with thicknesses smaller than 100 nm grown by reactive diffusion between a deposited nano-film and the substrate. The cases of silicides and germanides are particularly investigated, since silicides and germanides are used in microelectronics as ohmic contacts of silicon- or germanium-based transistors.

High-entropy alloys (HEAs) have been introduced as a novel class of multicomponent alloys, which contain constituents in equiatomic or near equiatomic proportions. Two chapters of this volume consider self- and impurity diffusion in high-entropy alloys.

Chapter 4 by S. Divinski, A. Pokoev, N. Esakkiraja, and A. Paul has the title '***A Mystery of 'sluggish diffusion' in High-entropy Alloys: the Truth or a Myth?***' This chapter shows that atomic diffusion in HEAs cannot a priori be considered as sluggish. Atomic interactions as well as correlation effects are responsible for the observed trends. Even if estimated on the same homologous scale, the diffusion retardation induced by 'high entropy' in FCC crystals is not simply proportional to the number of alloying components. The retardation is shown to be similar to one induced, e.g., by L1₂ ordering in a binary system. Furthermore, the importance of cross-correlations in diffusion of different species in HEAs is highlighted.

Chapter 5 is due to D.L. Beke and G. Erdélyi and has the title '***On the Self- and Impurity Diffusion in High entropy alloys***'. This chapter considers general trends in self- and impurity diffusion data for high-entropy alloys. The analysis is based on the similarity of interatomic potentials in metals.

H. Mehrer

The two volumes of Diffusion Foundations with the titles ***Diffusion in High-tech Materials*** and ***Diffusion and Thermal Transport in Bulk and Nano-materials*** are dedicated to the memory of Professor Dr. Nicolaas Augustinus Stolwijk

Nicolaas Augustinus Stolwijk, also called Nico by his friends, died suddenly and unexpectedly on May 22, 2017 at the age of 66 in his home near Münster, Germany. This was a shock for his wife Petra, his daughters Judith and Miriam, and his son Sebastian with family. Many friends from the diffusion community including myself, were deeply affected as well.

The diffusion community has lost a person with great merits in diffusion science. Nico performed studies, which covered a wide spectrum of diffusion processes. He studied diffusion in metals, in intermetallic compounds, in semiconductors, in solar grade silicon, diffusion and electrolytic conduction in polymer electrolytes, and diffusion in minerals. He also served the diffusion community as co-organizer of DIMAT 1996 in Nordkirchen near Münster and as organizer of DIMAT 2014 in Münster. During DIMAT 2017 in Haifa, Nico presented two remarkable papers. One week after he returned from Haifa to his home he passed away.



Nicolaas Augustinus Stolwijk was born in 1950 at Gouda in the Netherlands. He started to study physics in Utrecht already at the age of 17. He worked for his PhD in the group of Professor Hans Bakker at the University of Amsterdam. The topic of his PhD work was diffusion in the intermetallic compound cobalt-gallium. As a postdoc with an Alexander von Humboldt grant, Nico joined my diffusion group at the University of Stuttgart and started work on diffusion in semiconductors. In 1984 I received the chair and director position of the Institut für Materialphysik at the Physics Department of the University of Münster. Nico joined our group and received a permanent position as staff scientist. He got his Habilitation at the University of Kiel in 2001 and in Münster in 2005 with his research on 'Diffusion Behaviour and Electrical Properties of Point Defects in Semiconducting Elements, Alloys, and Compounds'. He became Professor in Münster at 2008. Nico was an invaluable support for the institute. He continued to work in this position after my retirement in 2006. He had successfully established a group of PhD and master students. In his group, about 27 PhD and master students performed diffusion studies in various materials and finished their thesis. Nico published 165 papers in peer-reviewed international journals and scientific articles in several books before he retired in 2015. Even after his retirement he guided several students who finished their thesis in his group.

Nicolaas Augustinus Stolwijk was a remarkable scientist and we will keep him in mind as a very likeable colleague and friend with an always supportive and positive attitude. Nico and I were good friends. We published more than 40 common papers on diffusion and point defects in semiconductors and many further papers on diffusion in metals.

Helmut Mehrer

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