

Juryrapport

Martinus van Marum Prijs 2023 – Exacte Wetenschappen (Wiskunde, Informatica, Natuurkunde en Sterrenkunde)

Dr. E.M.T. (Elham) Fadaly

'Epitaxy of Hexagonal SiGe Alloys for Light Emission'

Eindhoven University of Technology, April 2021

The jury of the Martinus van Marum Prize of 2023 convened after looking at a considerable number of PhD theses and recommendation letters. The jury concluded that there were many extremely high quality candidates.

Generally speaking, one can say that a jury will look for a thesis that is exceptional in quality and thoroughness and the winner might have stood out because it combines theory and experiment, both at a high level. Or a thesis might stand out because of a very original finding or by exceptional creativity. Sometimes a thesis wins a prize because it has solved a problem that has prevented an important application from advancing, especially if that problem went unsolved for many decades.

This year was different. The jury postulated that it may have been due to the pandemic. Obviously, the pandemic was devastating in many ways. On the other hand, judging by the quality of the theses that were nominated for the Martinus van Marum Prize, it appears that some people have become extremely productive in this period of solitary confinement. Among the nominated theses there were several theses that combined theory and experiment in an exceptional way, there were several that stood out because in addition they solved an important problem in a creative way.

This year's winner is Dr. Elham Fadaly. At Eindhoven University of Technology she has worked on changing the crystal structure of silicon-germanium (SiGe). We all know silicon as the building block and foundation of much of our technology. But its cubic crystal structure prevents this material from emitting light, despite significant efforts to change this.

Dr. Fadaly has realized the growth of high-quality SiGe for the first time in a hexagonal crystal structure. This required a deep understanding of the crystal growth mechanism of the template nanowires by a catalytic process and the Ge shell directly from the gas phase. In addition Dr. Fadaly showed efficient light emission up to room temperature (Nature 2020). The high efficiency was unexpected from theory. The work of Fadaly has demonstrated which was missing in the theory and showed that due to the randomness of the SiGe alloy, it has such efficient light emission.

In addition, Dr. Fadaly has revealed a new type of crystal defect, in this new material system, of which she studied the structural and electronic properties in great detail.

These findings, combined with the fact that the light emission has since been shown to also act as a laser, may be expected to have a long term impact on the industry and Dr. Fadaly has co-authored a foundational patent on this topic.

Dr. Fadaly's work on the demonstration of direct band gap emission from SiGe alloys in the hexagonal phase has generated a lot of attention in the professional literature and, while this is not so common in her field, Dr. Fadaly has given several talks at international conferences during her PhD.

Her work has been proclaimed the 'Breakthrough of the Year' by Physics World in December 2020 and she has appeared in popular science magazines and in radio and TV interviews, including an extended one for the BBC.

The jury hopes that this prize will encourage Dr. Fadaly to continue her outreach and exert her influence as a role model as she indeed has done in her discussions with a number of ministers in Egypt on the position of women in science.

We conclude that Dr. E.M.T. Fadaly is a very exceptional winner of the Martinus van Marum Prize 2023 and wish her all the best.

Prof. dr. ir. C.J. (Hans) van Duijn, oud-rector magnificus, emeritus-hoogleraar toegepaste analyse Technische Universiteit Eindhoven

Prof. dr. ir. R.L. (Inald) Lagendijk, Distinguished Professor in Computing-based Society Technische Universiteit Delft

Prof. dr. ir. T.H. (Tjerk) Oosterkamp, hoogleraar experimentele natuurkunde Universiteit Leiden

De jury kwam bijeen via Zoom op 21 maart 2023. De vergadering werd voorgezeten door Dr. W. (Willem) Bijleveld, maatschappelijk lid KHMW. Tevens waren ter vergadering aanwezig Prof. dr. A.P. IJzerman, secretaris natuur- en medische wetenschappen KHMW (notulen).