



This journal – the first of its kind in Costa Rica - showcases the work of students and faculty carried out as part of the focal point for scholarly basic and applied research on materials in the medical device field. Works carried out outside of the program on related topics are also welcome to submit a contribution.

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MIDM

*Maestría en Ingeniería
en Dispositivos Médicos*

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Main cover caption
Render of a vascular stent of a titanium alloy. Inset: scanning electron micrographs of Ti-6Al-7Nb; Image A: Quenched in liquid N₂ from 1010°C; Image B: Quenched in air from 960°C
Heat treatments can change the microstructure of these kind of materials, which can significantly change their mechanical properties. Image A shows a typical martensite of alpha-Ti, while Image B shows a duplex alpha-Ti matrix with a lamellar alpha+beta structure within the equiaxed alpha grains. The latter is a stronger structure with good elongation properties *SEM images courtesy of Joaquín González, Costa Rica Institute of Technology.*



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Welcome!



In the summer of 2013, CR government, industry and academic representatives led by CINDE traveled to the twin cities to visit with representatives of Minnesota's Medical Alley companies (e.g., Boston Scientific) and the University of Minnesota. The result was a memorandum of understanding between the CR Ministry of Science & Engineering and the U

of MN College of Science & Engineering and a commitment to collaborate on educational programs to serve CR's medical device manufacturing industry. Faculty from the Tecnológico de Costa Rica (TEC) and U of MN's technological leadership institute (TLI) formed a partnership that helped shape TEC's Master in Medical Devices Engineering curriculum. TEC and TLI are bound by a common interest in preparing engineers and scientists to be technical leaders in a global medical device industry that reaches all the way from Maple Grove and Arden Hills to El Coyol, Global Park and Cartago.

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We would like to thank everyone who contributed to the development of the Master in Medical Devices Engineering program. We are particularly thankful to CINDE, the Costa Rican Economic Development Agency, for their advice and support. CINDE organized initial meetings and facilitated our interactions with the University of Minnesota and the visits to the Boston Scientific facilities to gain insight into the educational needs of the medical industry. We are also very thankful to our Costa Rica Institute of Technology President, Dr. Julio Calvo, for his trust and support and to the School of Materials Science and Engineering, for their support in the design and implementation of these Professional and Academic Programs. Along the way many companies also supported the program by providing scholarships to our students, providing classroom space, organizing manufacturing plant visits and also providing instructors whose expertise and knowledge have raised the quality of the program. To these companies, whose logos are presented in the last page, we are very thankful.

The first group of students - 29 students from the professional track and two students from the academic track - graduated from the program in March, 2017. The second group of students is underway and looking forward to present their graduation projects in October. The third group started in January 2017. The program is growing and we look forward to even greater interactions with the industry and with local hospitals and doctors.

The first edition of the Journal is an effort to present the work done by students in their graduation projects. A Technical Committee has been created to review submissions and ensure their quality. As we prepare for future editions we would like to invite you to submit original research for possible publication. In this way, you can share your knowledge with the broader Medical Device industry in Costa Rica and elsewhere, and others can gain from it.

Tracing the path



It is with great pleasure that we publish this first issue of the Journal of Engineering in Medical Devices. The papers that are presented in this publication, collect selected works from the Graduate Program in Medical Devices Engineering of the Costa Rica Institute

of Technology. As the Editorial Director, I am very excited to witness the outstanding progress and achievements from the program so far. Contributions from industry and academia that fit the scope of the journal are welcome to submit a paper. The Graduate Program, which is managed by the School of Materials Science and Engineering, is unique in the sense that both a Professional and an Academic Program are administered. In the Professional Program, students are usually engaged with the Medical Device Industry, as direct collaborators, entrepreneurs, consultants and independent contractors. In the Academic Program, students with an interest in carrying out high impact scientific research can work under the supervision of principal investigators with research projects in Universities, National Laboratories and Research Centers.

The contents of the journal are presented in three sections, which we hope will carry the essence of our program in each issue we publish here onwards. The first section, **Applied Engineering**, presents contributions that apply the engineering design process to develop innovative medical devices, utilize problem solving methodology to the design of current medical devices, implement new designs and techniques for diagnosis

and treatment, carry out design of experiments and statistical analyses, as well as modeling and simulation, to the optimization of processes in the development and manufacturing of medical devices. Contributions of graduation projects from students from the Professional Program will be included in this section.

The second section, **Academic Focus**, summarizes the results of research projects from the Academic Program which have a high impact in a wide variety of areas of the research and development of medical devices, such as new materials for application in medical devices, design of innovative devices, new and improved manufacturing techniques, develop techniques for diagnosis and treatment, carry out design of experiments and statistical analyses, as well as advanced modeling and simulation of mechanical, thermal and functional behavior of medical devices.

The third section, **Technical Notes**, present letters intended for fast diffusion of new projects, ideas, prototypes and developments from upcoming projects and research being carried in the Program.

Finally, I would like to thank all the contributors, supervisors and reviewers for their hard work in bringing this issue to a reality. Hopefully this is the start of a long journey.

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