

Mechanical Engineering

Sinisa Vukelic

LECTURER IN DISCIPLINE
MECHANICAL ENGINEERING

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Sinisa Vukelic's research focuses on the alteration of mechanical properties of biomaterials subjected to ultrafast laser irradiation, with an emphasis on understanding underlying biochemical processes that occur when the laser treatment regime is confined below the optical breakdown. Vukelic has been working on the theoretical framework behind the low-density-plasma - tissue interaction mechanism, a novel phenomenon that enables alteration of the tissue properties without its disruption. This led to two distinct translational medicine efforts. The first is noninvasive permanent vision correction, which aims to provide new and groundbreaking paradigm in correction of refractive errors. Second is development of a novel treatment modality for early osteoarthritis (OA), a degenerative disease that affects millions of Americans. At the moment only late-stage treatment options are available, which are limited to major interventions, including joint replacement. Furthermore, Vukelic's research group, concurrently with development of the ultrafast laser-based therapeutic treatment, develops a Raman spectroscopy-based quantitative diagnostic method able to identify early OA. Treatment-diagnostics co-development approach aims to couple the treatment modality with molecular diagnostics and present it as a comprehensive approach for repair of an articular cartilage.

In addition to close collaboration with the Department of Ophthalmology, Dr. Vukelic has been collaborating with other physicians from Columbia University Medical Center to develop medical devices that could improve patient care. For example Dr. Vukelic has been working with cardiologists towards development of a medical device that measures fluid output in patients admitted to hospital due to failing heart condition. More recently Vukelic has been involved in two other medical device developments; an add-on device to spirometer which would increase compliance of sedentary patients in using it, and therefore reduce pulmonary complications; and a device what alleviates inflammation and pain of the upper aerodigestive tract.

Vukelic received a Dipl. Eng. in 2004 in mechanical engineering from University of Belgrade and a MS in 2005 and a PhD in 2009 in mechanical engineering from Columbia University.

RESEARCH INTERESTS

Mechanical properties and mechanics of collagen rich tissues, biomaterials and biological media, Laser material processing, molecular diagnostics and characterization, mechanical engineering

RESEARCH AREAS

Materials, Devices, Imaging, Modeling, Sensing, (Biomaterials)

LINKS

[LAB WEBSITE](#)

RESEARCH EXPERIENCE

- Adjunct Assistant Scientist, Hospital for Special Surgery 2010–2013
- Graduate research assistant, Columbia University, 2005-2009

PROFESSIONAL EXPERIENCE

- Lecturer in Discipline, Columbia University, 2013–
- Swanson Fellow Assistant Professor of Mechanical Engineering, Bucknell University, 2009–2013

PROFESSIONAL AFFILIATIONS

- American Society of Mechanical Engineers
- Materials Research Society
- SPIE – The International Society for Optics and Photonics

SELECTED PUBLICATIONS

- Wang, C, Fomovsky, M, Miao, G, Zyablitskaya, M, **Vukelic, S** (2018) Femtosecond Laser Crosslinking of the Cornea for Noninvasive Vision Correction, *Nature Photonics* 12, 416-422 (cover article of July 2018 issue)
- Fomovsky, M, Wang, C, Roland-Hall, J, Paik, DC, Trokel, SL, **Vukelic, S**, (2017) A New Paradigm for Use of Ultrafast Lasers in Ophthalmology for Enhancement of Corneal Mechanical Properties and Permanent Correction of Refractive Errors, *Proc. of SPIE* 10066, Energy-based Treatment of Tissue and Assessment IX, 100660Y
- Wang, C, Durney, KM, Fomovsky, G, Ateshian, GA, **Vukelic, S**, (2016) Quantitative Raman Characterization of Cross-linked Collagen Thin Films as a Model System for Diagnosing Early Osteoarthritis, *Proc. of SPIE Biomedical Vibrational Spectroscopy* 9704: 970415
- Guo, Y, **Vukelić, S**, (2015) “Evolution of cavitation bubbles in corneal stroma subject to micro-Joule femtosecond laser Pulses,” *Proc. of SPIE Optical Interactions with Tissue and Cells* 9321: 932106.
- Guo, Y, Wang, C, Celi, NG, **Vukelić, S**, (2015) “Femtosecond laser collagen cross-linking without traditional photosensitizers,” *Proc. of SPIE Optical Interactions with Tissue and Cells* 9321: 932103.