Thermoelectric expert visits Tyndall

Prof. Yaniv Gelbstein who is a well-known expert in the area of thermoelectric materials and devices is visiting Tyndall this week and will give a seminar on his recent research activities.

Prof. Gelbstein has specialized in thermoelectric (TE) materials since 1997. In the recent years he serves as the head of the Laboratory of Thermoelectrics and the chairman of the Discipline of Electronic Materials in the Department of Materials Engineering and was recently appointed to head the Unit of Energy Engineering, all at Ben-Gurion University of the Negev. Since 2013 Prof. Gelbstein is also an Associate Member in the "Laboratory on Direct Energy Conversion and Nano-engineering of Thermoelectric Structures" in St. Petersburg National Research University of Information Technologies, Mechanics and Optics (NRU ITMO). Prof. Gelbstein is regularly invited to take a part in international advisory boards and scientific committees in TE related symposia and conferences (e.g. CIMTEC 2014, (Tuscany, Italy), ICT-2009 (Freiburg, Germany), and EMRS-2008 (Strasbourg, France)) and to chair TE Symposia (e.g. EnMat II, 2013, Karlsruhe, Germany). He also serves on a regular basis as a project proposals evaluator in the field of renewable energy for the Georgia National Science Foundation (GNSF) and the Israeli Ministry of Science, Technology and Space. From 2009 Prof. Gelbstein served also as a guest editor of special issues on thermoelectrics in the Journal of Nanothermoelectrics (De Gruyter Open) and the Journal of Electronic Materials (Springer). In the last 5 years, 72 articles were published in scientific journals/conference proceedings and 46 invited lectures and 101 presentations in scientific conferences were given, all in the field of TE.

Presentation abstract:
Advanced Thermoelectric Optimization Approaches
In the recent years, demands for energy efficiency have motivated many researchers globe-wide to seek for innovative methods capable of enhancement the efficiency of heat to electricity thermoelectric (TE) energy conversion. Many of these methods incorporated interfaces and sub-micron features, which are much more effective in phonon scattering (rather than electron scattering), for reduction of the lattice contribution to the thermal conductivity, without adversely affecting the other involved electronic properties. Although such an approach resulted in increased TE efficiencies, stabilizing the nano-centers while preventing coarsening under practical operation conditions, combined with an additional electronic optimization, is still required.

The presentation will cover a combination of several novel methods approaching toward a higher technology readiness level (TRL) of TE devices. These methods include:

-Phase separation into the sub-micron scale with an enhanced thermodynamic stability.

-Co-doping of known thermoelectric compounds, while one doping element introduces vacancies which are occupied by another doping element, for optimizing the electronic TE properties.

-Functionally graded materials (FGM) generation, with an optimal ZT envelope over a wide temperature range.

Besides of the listed above approaches for optimizing the TE compositions, the presentation will cover some of the procedures required for development of practical TE devices.