Defence of a Doctoral Thesis

Nanomechanics – Quantum Size Effects, Contacts and Triboelectricity

Martin Olsen

Thesis for Doctoral Degree in Engineering Physics
Department of Natural Sciences
Faculty of Science Technology and Media
Mid Sweden University

Abstract

Nanomechanics is different from the mechanics that we experience in everyday life. At the nano-scale, typically defined as 1 to 100 nanometers, some phenomena are of crucial importance, while the same phenomena can be completely neglected on a larger scale. For example, the feet of a gekko are covered by nanocontacts that yield such high adhesion forces that the animal can run up on walls and even on the ceiling. At small enough distances, matter and energy become discrete, and the description of the phenomena occurring at this scale requires quantum mechanics. However, at room temperature the transitions between quantized energy levels may be concealed by the thermal vibrations of the system. As two surfaces approach each other and come into contact, electrostatic forces and van der Waals forces may cause redistribution of matter at the nano level. One effect that may occur upon contact between two surfaces is the triboelectric effect, in which charge is transferred from one surface to the other. This effect can be used to generate electricity in triboelectric nanogenerators (TENGs), where two surfaces are repeatedly brought in and out of contact, and where the charge transfer is turned into electrical energy.

This thesis concerns nanomechanics addressing whether quantum mechanics play a role in elastic deformation, as well as various mechanical aspects of nanocontacts including electric charging. The objectives are to contribute to the understanding when quantum effects are of importance at the nanolevel, increase the fundamental understanding of the mechanisms responsible for triboelectric phenomena and apply the triboelectric effect to a wind harvesting device.
Read the whole abstract on **miun.se**

Date	June 5th 2019 10:15
Place	Campus Sundsvall O102
Supervisors	Docent Jonas Örtegren Professor Håkan Olin Professor Per Gradin Associate Professor Peter Glans
External reviewer	Professor Rusen Yang
Examining committee	Professor Bengt Oelmann Professor Nils Almqvist Docent Yijun Shi

Mittuniversitetet
MID SWEDEN UNIVERSITY