MECHANICAL ENGINEERING STUDENT SEMINAR

Thursday, January 25 2024 at 11:00 (Jerusalem time) and 17:00 (Beijing time)
Online: https://gtiit.zoom.us/j/8580288220?omn=95220498424

Instruments and methodologies for studying the electron wind force effect on twin boundaries

MSc student: Qingxing Duan

Adviser: Prof. Doron Shilo (Technion) and Prof. Yuanshen Qi (GTIIT)

The significant drop of flow stress in metallic materials during plastic deformation through the utilization of electric current pulses, i.e., electropulsing (EP), is referred to as the electroplastic effect. Despite EP treatment has been a research topic for more than six decades and being applied in the industry, the underlying mechanisms of the electroplastic effect, e.g., is it related to momentum or energy transfer, have not been fully understood. Most of the experimental studies of the electroplastic effect measured the change of the overall plastic deformation under EP treatment and did not look into the behavior of individual defects. More specifically, there have been no studies investigating the influence of EP on the behavior of twin boundaries.

In this work, new instruments and methodologies have been developed, for studying twin boundary motion induced by EP. The setup includes various electric pulsers with pulse durations ranging between 0.1 to 20 μs and an experimental platform that enables tracking the motion of individual twin boundaries under an optical microscope equipped with a high-speed camera. Further, we measured the average sample temperature using a fast thermocouple and the local temperature changes in the vicinity of the twin boundary by high-speed IR microscopy. The results revealed the motion of twin boundaries at the microsecond and micrometer scales and enabled us to determine the physical effect that induces this motion.

We found that twin boundaries in Ni-Mn-Ga shape memory alloy move in direct relation with the transferred electric energy. We analyze the possible reasons for this behavior and indicate the most probable among them.

Note: the seminar will be given in English

Seminars Coordinator: Assoc. Prof. Shmuel Gal.