Department of Materials Science and Engineering

Iby and Aladar Fleischman Faculty of Engineering Tel Aviv University

הפקולטה להנדסה
ע"ש איבי ואלדר פליישמן
אוניברסיטת תל אביב

המחלקה למדע
והנדסה של חומרים

You are cordially invited to attend this seminar to be held on

Tuesday, March 6th, 15:00

Room 206, Wolfson Mechanical Engineering Building

Piezoelectric Loss Characterization

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ICAT/PSU has been working on the loss characterization of piezoelectrics for 30 years. In the 1980s, we started the hysteresis measurement by using a pseudo-DC technique for measuring the hysteresis directly, and a resonance drive method under a large AC voltage. Since we found a significant distortion/hysteresis in the admittance spectrum, we adopted a current constant method in the admittance measurement in the 1990s. In the 2000s, we further developed a High Power Characterization System (HiPoCS), which is capable of measuring the admittance curves under the constant vibration velocity of a piezoelectric sample. By keeping the same vibration level (i.e., the mechanical energy density constant), voltage and current are simultaneously changed, so that a symmetrical admittance spectrum can be obtained for both resonance and antiresonance peaks. We reported first that (1) the mechanical quality factor at the antiresonance, QB, is higher (the peak is sharper) than QA at the resonance in PZT materials, different from the IEEE Standard's assumption, (2) the power required for generating the same tip vibration velocity of the rectangular plate is smaller for the antiresonance mode than that for the resonance mode, concluding (3) the higher efficiency at the antiresonance than that at the resonance in PZT plates. In the 2010s, we established a comprehensive burst mode method in HiPoCS. In the transient burst method, the ceramic is excited for a set number of cycles (i.e., no heat generation), after which open circuit (antiresonance) or short circuit (resonance) conditions are imposed on the sample. The decay of current or voltage allows for the calculation of the quality factors, QA at resonance or QB at antiresonance, respectively, according to vibration velocity. The piezoelectric charge constant d and elastic compliance s can be determined for k31 resonators under the short circuit condition. Also, the force constant A is described by the ratio (current/vibration velocity). In addition, we introduced a voltage constant B, a ratio (voltage/displacement) for the resonators in their antiresonance mode, and we firstly determined the permittivity   at the resonance frequency region from the ratio of (A/B).

Kenji Uchino, the pioneer in 'piezoelectric actuators', is ***Founding Director of International Center for Actuators and Transducers***, Professor of EE and MatSE, and Distinguished Faculty of Schreyer Honors College at The Penn State University. He was ***Founder and Senior Vice President of Micromechatronics Inc.***, State College, PA from 2004 till 2010, and ***Associate Director at Office of Naval Research – Global*** from 2010 till 2014. After his Ph. D. degree from Tokyo Institute of Technology, Japan, he became Research Associate (1976) at this university. Then, he joined Sophia University, Japan as Associate Professor in 1985. He was recruited from The Penn State in 1991. ***Fellow of American Ceramic Society and IEEE***