Seminar by Joint IEEE Ottawa-Montreal Section DEIS Chapter,
IEEE Ottawa PES & IMS Chapters, and EPMG of INMS/NRC

The IEEE Ottawa Section is inviting all interested IEEE members and other engineers, technologists, and students to a seminar on dielectrics and electrical insulation.

Multi-excitation entropy, Meyer-Neldel rule, and the physics of dielectric materials

by

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DATE: Friday March 07, 2008.
TIME: 10:30 a.m. Registration and Networking; 11:00 a.m. – 12:30 p.m. Seminar.
PLACE: National Research Council, 1200 Montreal Road, Ottawa, Building M-50, Room 115.
PARKING: No fee at the visitor's parking. Please respect restricted areas.

Abstract When the activation energy of a kinetic process is much larger than the available excitations, usually phonons or IR vibrations, and kT, there is an entropy associated with the fluctuation which provides this energy. This multi-excitation entropy (MEE), which increases with the activation energy or enthalpy, may be very large. This has major consequences for physical and chemical processes in a wide range of circumstances.[1] In particular, they are important for the properties, both atomic and electrical, of dielectric materials.

Undoubtedly, the most important consequence of MEE is the Meyer-Neldel (MN) rule, which relates the prefactor and the activation term in the Arrhenius equation. For atomic diffusion in crystals, Wert, Zener, and Keyes developed a mechanistic model, also based on entropy, which was extended to polymers by Lawson, and developed by Crine and Sammis. We propose that, in the circumstances in which this model is pertinent, the two approaches are simply different ways of looking at the same idea. Unfortunately, there are presently very few mechanistic or atomic models for other circumstances.

We discuss the observed values of the MN energy for many processes and their relation to the energies of excitations, and the "inverse MN rule," which is observed only when the condition for MEE is not fulfilled. We explain the correlation between the conductivity prefactor, σ_{oo}, and the MN energy, which has been observed in a number of cases, especially for chalcogenide glasses, and discusses its implications concerning the nature of the charge carriers. Recognizing that the total entropy in the free energy of activation is generally not limited to the MEE term allows us to understand the rates of processes such as charge carrier detrapping, and to suggest that the MEE approach can continue to be explored for new insights.

Arthur Yelon After graduate studies at Case Institute of Technology, Arthur Yelon held positions at IBM Yorktown Heights, CNRS Grenoble, and Yale University, before joining École Polytechnique Montréal, where he is now an Emeritus Professor. Over the years, he has been involved in investigations of a wide range of problems in applied solid state physics. These include conduction and breakdown mechanisms in insulating polymers, and ageing of amorphous semiconductors. His present activities are centered primarily on the properties and applications of metallic magnetic micro- and nanowires, and nanowire arrays, and on multi-excitation entropy, on which he has been working since 1989. Prof. Yelon is a Life Fellow of IEEE.

Admission: Free. Registration required for security reasons.
To ensure a seat, please register by e-mail contacting: maboudakka@ieee.org