square of the local BCS temperature dependence of the penetration depth. If the current distribution in the film is assumed to be uniform, the zero degree penetration depth, λ(0), may be determined. A value of the density of states at the Fermi surface, N(0), may be calculated from λ(0) based on the BCS expression for the penetration depth in a "dirty superconductor."

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MONDAY MORNING, 19 MARCH 1973 (F. BRIDGES presiding) ISLAND ROOM AT 9:30 A.M.

ENDOR, Paraelectric Centers

AI 1 Paraelectric Impurities in Sodalite. A. T. FIORY, Bell Laboratories, and R. C. ALIG, RCA Laboratories. --Sodalite, $Na_8Al_6Si_6O_{24}X_2$, where X is a halide, is a framework aluminosilicate. The interstices of this framework contain 4 Na+ ions tetrahedrally coordinated about the halide ion. The halide ion may be replaced by an OH- impurity. Measurements at .02 and 410 Hz of the capacitance and dielectric loss of a bromide-sodalite powder containing 2 per cent OH- impurities exhibit an interval in temperature between 20 and 100 degrees K wherein the dielectric constant is a decreasing function of temperature. This data is fitted with a relaxation process having an activation energy of 36 meV, an attempt time of 30 psec, and a dipole moment of 1.1 D. Additional measurements on bromide sodalites with other OH- concentrations and on sodalites with other halides are planned.

AI 2 Tunneling Splitting and Elasto-Optical Behavior of the Vibrational Absorption of CN^- Molecules in KCl.* F. LÜTY, Univ. of Utah.--In previous work, the vibrational absorption of CN^- in KCl was found to be strongly broadened by an unresolved tunneling splitting, and was reported to exhibit pure zero moment changes under applied stress, indicating <100> symmetry of the defect.[1] It will be shown that this contradicts the tunneling model, which predicts for any absorption with a width determined by tunneling motion pronounced anisotropic changes of the spectral shape under applied stress or fields. A thorough reinvestigation of the KCl:CN^- system agrees with this expectation and yields the following results: a) The tunneling splitting (~ 1.2 cm^{-1}) can easily be resolved in the first and second harmonic CN^- vibrational absorption for crystals with small CN^- concentration. b) The predominant effects from stress application at low temperatures are changes of the spectral shape of the vibrational absorption. c) The pronounced anisotropy of the latter effect indicates <110> orientation of the CN^- dipoles in the crystal and predominant 90° (next nearest neighbor) tunneling.

*Supported by NSF Grant # GH33704X.
[1]W. D. Seward and V. Narayanamurti, Phys. Rev. 148, 1, 1966.

AI 3 Elastic Dipole Tensor and "Dressed" Tunneling Motion of Off-Center Ag^+ Ions in RbCl and RbBr.* R. JIMENEZ† and F. LÜTY, Univ. of Utah.--Substitutional Ag^+ ions in RbCl and RbBr have previously been found to occupy <110> oriented off-center sites and to reorient preferentially by 90° tunneling.[1] The unexpected predominance of next-nearest (90°) over nearest neighbor (60°) tunneling was tentatively ascribed to a strong "dressing" of the dipole with an elastic E_g distortion, which hinders the 60° reorientation, but allows easy reorientation (around a fixed E_g distortion) through 90° angles in a <100> plane. This makes the Ag^+ dipoles an important test case for the "dressed tunneling model", allowing an experimental comparison of the two reorientation parameters (for 60 and 90° motion) to their relevant elastic dressing parameters (of T_{2g} and E_g symmetry). Using stress-optical measurements at low temperatures on differently oriented RbCl:Ag^+ and RbBr:Ag^+ crystals, the elastic dipole components of the off-center Ag^+ defects were determined and are compared to the dressed tunneling reorientation model.

*Supported by NSF Grant # GH33704X.
†Supported by a fellowship from ESFM (Mexico).
[1]S. Kapphan and F. Lüty, Phys. Rev. B 6, 1537 (1972).

AI 4 Infrared "Tunneling Transitions" of an Electron Bound to a Pair of Anion Vacancies in Alkali Halides.* S. MORATO† and F. LÜTY, Univ. of Utah.--An electron, bound to a <110> neighboring pair of anion vacancies ("F_2^+ center") in alkalihalides, behaves in its optical transitions very closely to a H_2^+ molecule in a dielectric medium.[1] Specifically the lowest optical excitation $1s\sigma_g \rightarrow 2p\sigma_u$ (at 1.4μ in KCl) can be regarded as the transition between the symmetric and antisymmetric LCAO (1s) states at the two vacancies, separated by the tunneling splitting of the divacancy system. Using the dielectric H_2^+ molecule model, it can be predicted that a series of discrete IR tunneling transitions should exist for the different possible configurations of divacancies (e.g., <200>, <211>··, etc.), extending farther out into the IR range with increasing vacancy distance. The predicted properties of these transitions and their potential for electric field experiments and possible tunable IR emission will be discussed. Preliminary results of the experimental search for these transitions will be reported.

*Supported by NSF Grant # GH33704X.
†Supported by a fellowship from FAPESP (Brazil).
[1]M. Aegerter and F. Luty, Phys. Stat. Sol. 43, 245 (1971).

AI 5 Stress-tunable Orbach Relaxation and Tunneling Parameters of Paraelectric Defects.* J. WAHL and F. LÜTY, Univ. of Utah.--It will be shown that for a paraelectric defect system of given orientation, uniaxial stress, applied in a particular symmetry direction, can shift to higher energies the orientational levels, which are necessary as intermediate states for dipole relaxation under an electric field applied perpendicular to the stress. Therefore the dielectric relaxation due to the predominant tunneling process becomes an Orbach process, which can be tuned by the applied stress to small rates, until the next probable (stress independent) tunneling process becomes effective. As a first example for this method, the dielectric loss of <100> oriented OH^- dipoles in KBr was measured in a [100] applied AC field at low temperatures. Under [011] applied stress the relaxation rate shifts drastically to smaller values (up to 4 orders of magnitude!), while the height of the Debye relaxation curve increases. The measurements are in agreement with the tunneling model and show that tunneling by 180° reorientation is at least 2 orders of magnitude less probable than the predominant 90° tunneling process. The potential of this method for other dipole systems will be discussed.

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