AND R. B. SCHOOLAR, *U. S. Naval Ordnance Laboratory*.—Thin single-crystal films of PbTe and SnTe have been produced by vapor deposition on a cleaved alkali-halide surface. The methods employed are similar to those previously reported.[1,2] Electrical, optical, and x-ray data confirm the fact that these films are single crystalline. The electrical measurements on PbTe yield mobilities that are within a factor of 5 of the bulk mobility at 77°K. The mobility of SnTe is the same as the bulk down 77°K. The results of optical measurements are reported.

[1] R. B. Schoolar, J. D. Jensen, and J. N. Zemel, Bull. Am. Phys. Soc. 8, 63 (1963).
[2] J. D. Jensen, R. B. Schoolar, and J. N. Zemel, Bull. Am. Phys. Soc. 8, 63 (1963).

CA8. Slow-Relaxation Phenomena of HF–HNO_3-Treated Ge Surfaces. M. H. PILKUHN, *IBM Thomas J. Watson Research Center*.—The influence of H_2O on the slow-surface states was studied in detail. $-H_2O$ decreases the time constants of the slow states drastically, and this change during the uptake of H_2O was studied at different surfaces. The relaxation times were found to be temperature-dependent in all cases, but H_2O hardly seemed to influence this temperature dependence and the activation energy involved. At pressures below 10^{-6} Torr and temperatures of 80°C, saturation of slow states was observed. Light was found to have no or very little influence on the time characteristics of the slow relaxation. The experimental results are discussed in view of different models.

MONDAY MORNING AT 10:45

St. Louis Room, Statler–Hilton

(C. A. HUTCHISON, JR., presiding)

Chemical Physics I

D1. X-Ray Scattering by Noncrystalline Viruses.* V. L. BADILLO (introduced by A. H. Weber) AND A. H. WEBER, *Saint Louis University*.—Tobacco Mosaic Virus (TMV) and Turnip Yellow Mosaic Virus (TYMV) specimens, compressed into cylindrical pellets to avoid scattering by binders or containers, produced patterns with halos at $s=1.45$, 2.80, and 5.50 $Å^{-1}$ for TMV and at $s=1.35$, 2.80, and 5.40 $Å^{-1}$ for TYMV. The intensity data were inverted to obtain electron-radial-density distribution functions.[1] Background scattering was determined by empirically drawing a smooth curve through the oscillations in the total-scattering-intensity curve.[2] Maxima were at $r=1.45$, 2.52, 3.55, 4.90, and 5.90 Å in the radial-density curve of TMV and at $r=1.50$, 2.65, 3.79, and 4.75 Å for TYMV. The intensity and radial-density curves are similar to those for α protein.

* Work supported by the American Cancer Society and the National Science Foundation.
[1] B. E. Warren, H. Krutter, and O. Morningstar, J. Am. Ceram. Soc. 19, 202 (1936).
[2] I. Karle and J. Karle, J. Chem. Phys. 18, 957 (1950).
[3] U. W. Arndt and D. P. Riley, Phil. Trans. Roy. Soc. (London) A247, 409 (1955); D. P. Riley and U. W. Arndt, Nature 169, 138 (1952).

D2. NMR of P^{31} in Solutions of RNA. B. J. WYLUDA (introduced by J. Eisinger), J. EISINGER, AND R. G. SHULMAN, *Bell Telephone Laboratories*.—Measurements of the P^{31} NMR in aqueous solution of yeast RNA in the presence of Mn^{2+} prove that the Mn^{2+} ions are bound to the phosphate group of the RNA. The relaxation times T_1 and T_2 were measured by power saturation and linewidths, respectively, and were found to be inversely proportional to the Mn^{2+} concentration. Typical values are $T_1=6.0\times10^{-4}$ sec and $T_2=5.6\times10^{-4}$ sec for $[Mn^{2+}]/[PO_4]=0.018$. Since T_1 is limited by dipolar interactions with the bound Mn^{2+}, it is possible to evaluate the dipolar correlation time. The shorter values of T_2 are consistent with a value for the Mn–O–P isotropic hfs of 1.1×10^{-4} cm^{-1}, which is derived from the P^{31} resonance shifts[1] in crystals. By assuming this value, it is possible to calculate that the correlation time for the Mn–O–P isotropic hfs is 9×10^{-10} sec. Similar measurements of T_1 and T_2 in *E. Coli* ribosomes, which are 62% RNA, gave almost identical results. The influence of Ni^{2+} and Fe^{2+} upon the P^{31} resonance is presented.

[1] J.M. Mays, Phys. Rev. 108, 1090 (1957).

D3. Proton-Relaxation Enhancement in Nucleic-Acid Solutions. W. E. BLUMBERG, J. EISINGER, FAIZA FAWAZ-ESTEUP, AND R. G. SHULMAN, *Bell Telephone Laboratories*.—Measurements of T_1 and T_2 of the water protons in aqueous solutions of nucleic acids and magnetic metal ions allow one to determine details about the metal-ion binding. When Mn^{2+} is bound, the rotation of its hydration sphere becomes slower, so that its effectiveness in reducing the proton T_1 is enhanced. This relaxation enhancement has been measured for Mn^{2+} bound to DNA, RNA, synthetic polynucleotides, and *E. Coli* ribosomes. Compared to water as unity, the enhancement factors range from 4.2 for polycytidylic acid to 26 for RNA. The equilibrium constants for binding and the concentration of binding sites have been calculated from the dependence of enhancement upon Mn^{2+} concentration. ESR measurements of the Mn^{2+} ion in solution have confirmed these values for RNA and *E. Coli* ribosomes. Only the Mn^{2+} in solution contributes to the signal, presumably because the bound Mn^{2+} has a line broader than 1000 G and is not observed. For both yeast RNA and ribosome solutions at $[Mn^{2+}]=2.35\times10^{-3}M$, the individual hyperfine lines broaden appreciably when $[PO_4]>1.5\times10^{-2}M$. This broadening occurs when the lifetime of the Mn^{2+} ion in the unbound state becomes shorter than its electronic relaxation time.

D4. ESR of Fe^{3+} in Nucleic Acids. R. G. SHULMAN AND W. M. WALSH, JR., *Bell Telephone Laboratories*.—Samples of calf thymus DNA and yeast RNA have been exposed to low concentrations of Fe^{3+} ion in water solution. The ESR spectra of the dried, doped nucleic acids have then been observed at 12 and 35 kMc/sec and at various temperatures. Paramagnetic resonance peaks are reproducibly found at g values of 2.0 and 4.3. The former absorption indicates a nearly cubic local environment around the Fe^{3+} ion and is thought to correspond to ions bound on the exterior of the macromolecules, presumably at phosphate sites. The peak at $g=4.3$ is characteristic of a highly asymmetrical local electric field at the 100-ion site ($E>D$ and $h\nu$) and may result from binding of Fe^{3+} between paired bases of the nucleic acids. In addition a resonance line is often observed at $g\sim2.2$ whose intensity is independent of temperature. It is attributed to ferromagnetic precipitates nucleated on and trapped by the nucleic acids.