The Hopkins experimenters did microwave conductivity measurements[5] on both (TTF)(TCNQ) and (ATTF)(TCNQ), inserting a small crystal in a microwave cavity and observing how the cavity resonance is spoiled by the dielectric properties of the crystal. The microwave conductivity followed the dc conductivity. They found no evidence of paraconductivity in (TTF)(TCNQ), but Aaron Bloch of the Hopkins group points out that their experiments say nothing about the three anomalous Penn crystals. Hopkins would not be able to use these crystals in their microwave cavity because the crystals have been coated with silver paint to do the dc experiments. The Hopkins group has tried about 150 crystals of (TTF)(TCNQ) and failed to observe any anomalous conductivity.

Unlike the Penn experimenters, the Hopkins team was able to make absolute conductivity measurements in (ATTF)(TCNQ). The maximum microwave conductivity observed was about 2000 $(\text{ohm-cm})^{-1}$, a bit smaller than the conductivity of ordinary (TTF)(TCNQ), far from the paraconducting range. According to the Hopkins data, (ATTF)(TCNQ) shows no evidence of superconducting fluctuations.

Last year, Bloch, R. B. Weisman and Chandra Varma had collected data on the one-dimensional materials known then to have high conductivity and suggested that the conduction was determined by structural disorder. (TTF)(TCNQ), on the other hand, was not expected to show disorder, and that was one reason why the Hopkins group had decided to synthesize it.

Bloch does not believe that the Russian observations should be interpreted as showing ferroelectricity in the conventional sense. Rather, he says, the high dielectric constant they see is probably caused by hopping conductivity between electronic states localized by the disorder.

The work at Brown Boveri Research Center in Baden, Switzerland, led by Hans Rudy Zeller, was on single crystals of $K_2Pt(CN)_4Br_{0.3}\cdot3H_2O$, which Zeller says is much closer to being a one-dimensional electronic system than the (TCNQ) salts. By three separate experiments Zeller and his collaborators believe they have definitely demonstrated the existence of a Peierls instability. Zeller notes that the Penn group had merely suggested that they might be seeing the Peierls instability in (TTF)(TCNQ). The first experiment, using diffuse x-ray scattering, was done by Robert Comès and his collaborators (Orsay and Brown Boveri) and Zeller. The second, done by inelastic neutron scattering, was a joint effort by groups at Karlsruhe, Brown Boveri and Orsay. The third piece of evidence is from optical data obtained at Brown Boveri.

Zeller told us that at room temperature, where they see the Peierls instability, they find spurious conductivities and that this effect is directly comparable to the Penn observations at 60 K, where they reported a possible Peierls instability. Zeller and his colleagues find that in the vicinity of the transition, with statistics comparable to Penn's, that the conductivities are sometimes very high and sometimes even negative. He explained that theory predicts that there will be a maximum in the anisotropy in the vicinity of the transition, and if the sample is highly anisotropic a four-probe measurement, such as the Penn experimenters used, is generally very bad technique. Zeller believes that it is very possible the Penn group did not measure the true conductivity in the three crystals of (TTF)(TCNQ). —GBL

References

1. L. B. Coleman, M. J. Cohen, D. J. Sandman, F. G. Yamagishi, A. F. Garito, A. J. Heeger, Sol. St. Comm. **12**, 1125 (1973).
2. J. Bardeen, Sol. St. Comm, **13**, 357 (1973).
3. P. Lee, T. M. Rice, P. W. Anderson, Phys. Rev. Lett. **31**, 462 (1973).
4. L. I. Buravov, M. L. Khidekel, I. F. Shchegolev, E. G. Yagubskii, JETP Lett. **11**, 99 (1970).
5. A. N. Bloch, J. P. Ferraris, D. O. Cowan, T. O. Poehler, Sol. St. Comm. **13**, no. 4 (1973).

Magnetite used to monitor functioning of human lung

A new technique for monitoring lung contamination and function has been reported[1] by David Cohen of the Francis Bitter National Magnet Laboratory (MIT). The diagnostic handle is magnetite dust, which normally occurs in such low levels in the lungs as to be measurable only in a magnetically shielded room with sophisticated apparatus. Higher amounts of magnetite dust in the lungs can be seen, though, even with a relatively simple and inexpensive flux-gate magnetometer.

Cohen's work is following two primary directions. Under specified conditions the amount of asbestos in a person's lungs can be monitored magnetically because the mineral asbestos commonly coexists with a low concentration of magnetite (Fe_3O_4). Cohen found that if the person is placed in a magnetic field (typically 500 gauss), any ferromagnetic materials in the body such as magnetite respond and a residual magnetic field normal to the torso results. A map of the residual magnetic intensity can then be made; magnetite concentrations and hence asbestos concentrations can then be determined (after assaying the asbestos for magnetite). By this method the occurrence of asbestos in the lungs can be detected even before an x ray will show it. Iron in the body's organic compounds does not cause interference because the iron in that form is not ferromagnetic, Cohen said.

Experiments are underway to determine the sensitivity of the test and the minimal equipment necessary to test those who might inhale asbestos. In some cases it has been found that the fairly inexpensive flux-gate magnetometer is sufficiently sensitive to be of value, especially for testing people working in primary asbestos mining and milling areas.

A second use of magnetite dust is as a harmless tracer substance inhaled by the patient. Cohen explained, "Up to now the tracer material used has been radioactively tagged Fe_2O_3, but it doesn't seem to have the possibilities that magnetite has, partly due to regulations pertaining to radioactive substances. You can measure where magnetite goes, how fast it goes there and how fast the lung clears it out, an indication of the rate that dust is cleansed from the lungs."

Cohen and his collaborators have been involved with two other interesting lung phenomena. One process seen with this technique is the continuous rotation of dust particles in the lung by some viable process, which is not yet fully understood. The other phenomenon is that inhaled magnetite dust particles do not immediately line up when an external magnetic field is applied; there is a time lag of a second or two before they swing into line. "Measuring this time lag," said Cohen, "will give us a way of determining the viscosity of the material in which the particles are imbedded, which may be medically useful."

The equipment necessary to measure the asbestos-borne or purposely inhaled magnetite depends on the amount of magnetite likely to be present. Cohen uses a shielded room and a SQUID (superconducting quantum interference device) to measure residual fields of less than 20×10^{-7} gauss. If the residual field exceeds this figure, there is no need for a magnetically shielded room; the flux-gate magnetometer alone will suffice. Some asbestos miners tested in this way have had residual fields in the chest region of 150×10^{-7} gauss, which corresponds to 75 micrograms of asbestos per cubic centimeter of lung. —RAS □

Reference

1. D. Cohen, Science **180**, 745 (1973).