CHEMISTRY

New Crystals Replace Old

Barium titanate crystals which have the property of ferro-electricity will be used in sound and ultrasonic equipment. Only pinhead size crystals have been formed.

See Front Cover

➤ BARIUM titanate, a war-develped material with exceptional electrical behavior, will be replacing other crystals in submarine sound detection, and in other sound and ultrasonic equipment.

Some scientists expect that the future development of somewhat similar exceptional materials may lead to more effective electrical storage devices.

Barium titanate when treated as a ceramic, or clay-like material, looks very much like the porcelain of your kitchen sink. And it can be made in extremely thin slices needed for condensers.

At this time, scientists will admit only to pinhead size for the crystal form of barium titanate. Efforts are being made to grow crystals that are much larger.

The sensitive atoms of barium titanate show a remarkably quick response to the slightest changes in pressure, temperature or electrical field. Even light, shining on a crystal of it, will cause the atoms to rearrange themselves.

Scientists at the Massachusetts Institute of Technology, at the National Bureau of Standards, at Bell Telephone Laboratories, and in England, Holland and Russia among other countries, are busy investigating the properties of barium titanate and related compounds.

Reason for all this intense interest is that these materials have the property known as ferro-electricity. Only two other groups of compounds are known that exhibit this property. They are the Rochelle salts and the potassium dihydrogen phosphates.

The discovery of a group of materials so far superior in their electrical behavior to any compounds yet known is as important in the electrical field as the discovery of a new class of materials that would behave as iron does in the magnetic field.

Recognition of the far-reaching effects of the new class of materials was seen in the award of the Stalin Prize of Physics in 1946 to Prof. Bentsion Vul, then head of the laboratory of dielectrics in the Institute of Physics of the USSR Academy of Sciences.

Ability to increase to an exceptionally high degree the electrical capacity of charged plates is one of barium titanate's important characteristics. Physicists speak of this ability as the material's dielectric constant. Some estimates have placed the dielectric constant for barium titanate as high as 5,000, compared with about seven for mica. These figures are based on air having a numerical value of one.

Certain materials, called piezo-electric, will develop an electrical charge when their dimensions are changed. This would happen, for instance, when they were bent or pressed mechanically. These same materials will, conversely, change shape when they are placed in an electrical field.

It is this change in shape that makes possible the playing of a phonograph record. Here, the very tiny indentations in the groove of the record are picked up through the needle and sent back to the piezo-electrtic crystal. This causes a small change in the shape of the crystal. The electrical charge thus developed is amplified and comes out of the loudspeaker as sound.

Ordinarily Rochelle salts are used for this pick-up crystal, since they undergo electrical change with shape. The drawback is, however, that they lose some of this property on a very hot day, when the temperature is about 86 degrees Fahrenheit. Rochelle crystals are also very soluble in water.

Both of these difficulties are overcome in the barium titanate and related-type crystals. Experiments have shown that barium titanate does not lose its sensitivity until the temperature is well over 250 degrees Fahrenheit. Nor does it dissolve in water.

How powerful is the electric field of barium titanate can be seen on this week's cover of the SCIENCE NEWS LETTER. The electric field near the edge of the barium titanate crystal (black portion) distorts the shadow of the background screen of the electron microscope.

First hint of the unusual properties of barium titanate came from the Titanium Alloy Manufacturing Company of Buffalo, N. Y. They were investigating materials suitable for use in condensers, vitally needed for the war effort. Quartz and mica, the two most commonly used materials, were in extremely short supply. Development of barium titanate suitable for commercial use in condensers did not come until late in the war effort.

Physicists at MIT, upon hearing of the exceptional qualities of barium titanate, started an investigation of its atomic structure. This was in an effort to understand why it had such an unusual behavior in an electrical field.

Dr. Shepard Roberts, now at the Research Laboratory of General Electric Company, was the first to discover the ferro-electric properties of barium titanate. War-time research at MIT was led by Dr. A. von Hippel, working in cooperation with Drs. R. G. Breckenridge, F. G. Chesley and Laszlo Tisza.

Dr. B. T. Matthias, who started his investigations of the compound in Switzerland and continued them at MIT, is spearheading the work at Bell Telephone Laboratories.

Science News Letter, January 28, 1950

SAFETY

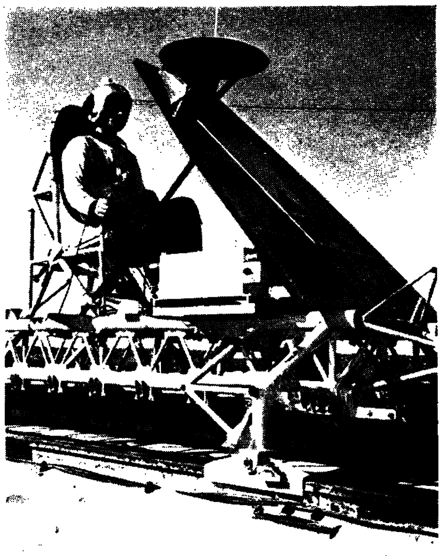
Auto Skidding Tests on Ice and Snow Are Underway

➤ THE frozen surface of Pine Lake in Clintonville, Wis., and hard-packed snow on neighboring roads, are now in use by a party of about 50 engineers conducting two weeks of testing of automobile skidding and traction.

The scientists are from all parts of the United States. They are members of a special committee of the National Safety Council on winter driving hazards. Ross G. Wilcox of this organization is in charge. The purpose is to determine the facts about the value of winter tire treads and special winter retreads, and also of skid chains and driving techniques.

Somewhat similar tests have been made in previous years. Lessons learned by these experts, passed on to the public, are expected to prevent skid-wrecks and traffic tie-ups which cost the American driving public many millions of dollars each year.

Science News Letter, January 28, 1950



DECELERATOR RIDE—An Air Force volunteer awaits the firing of the rockets for another jolting decelerator ride. The disk at the upper edge of the windshield supports a telemetering antenna, which broadcasts signals denoting the volunteer's reactions during decelerator experiments.