and semiconductor devices were devoted largely to the switching of the silicon controlled rectifier in power-control and conversion circuits. Considerable interest was expressed by the audience in time-ratio control; this was evidenced by a stimulating discussion period in which many persons participated and which finally had to be cut off by the session chairman.

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Optical Masers

Topics on the preparation of laser materials and sensitized luminescence were emphasized at the Optical Maser Symposium held at the Toronto (Canada) meeting of the Electrochemical Society, 6–7 May 1964.

K. Nassau (Bell Telephone Laboratories) summarized the successful optically pumped, inorganic, solid state laser materials which he considered to be well authenticated. His list included four categories: ruby, fluorides, scheelites, and glasses. With the exception of ruby, all these hosts are activated with rare earths. Nassau emphasized that after 4 years of laser research there are still no reliable guidelines that one can follow in developing a new laser material. For example, one might expect the emission lines of neodymium-doped lanthanum fluoride to be narrower, hence better suited for a laser, than the emission lines of neodymium in $CaWO_4$. This is not the case even though there is a closer chemical and physical similarity between Nd^{+3} and La^{+3} than between Nd^{+3} and Ca^{+2} and no need exists for charge compensation in LaF_3. Laser materials research is still at the point of growing a crystal, preparing a laser rod, and testing it.

Most of the chemical problems of laser materials development relate either to the necessity of compensating for the excess positive charge when a trivalent activator ion is substituted for a divalent host lattice cation or to the difference of the solubilities of the activator ions in the solid and liquid host. As the method of charge compensation changes, the spectrum of the laser material changes. The preparative problem is to find that technique which yields the spectrum best suited for laser action. The segregation of the dopant ions from the crystals, as they are grown from molten material, complicates the problem of producing a homogeneous, properly compensated laser rod.

L. G. Van Uitert and J. E. Geusic (Bell Telephone Laboratories) discussed the preparation and observation of laser action in garnets doped with neodymium. They believe that this material is potentially better than previously developed materials because of its lower threshold, simple preparation, and higher quality output.

Work at the Airtron Division of Litton Industries on the growth of ruby crystals by hydrothermal and molten salt solution techniques was described. Nearly all the ruby laser crystals have been grown in the past by the flame fusion technique, in which the material in powder form is dropped onto a seed and fused by a flame directed onto the seed. The crystals that result from this comparatively violent method of growth tend to be optically inhomogeneous, and consequently the laser performance is considerably less than ideal. Because ruby is one of the most widely applied laser materials, there is an interest in developing the techniques of growth from solutions, which should be more controllable. The apparatus used in this work, particularly for the growth from molten salt solvents, is impressively large; the furnace is several feet in diameter. Unfortunately, the ruby crystals are still small compared to those grown by the flame fusion technique and vary in chromium content, which is the active ion in the ruby laser. The crystals grown from solution do have fewer strains and thus better optical homogeneity.

Because of their narrow emission lines, rare earth ions have been the activators in nearly all optically pumped lasers. However, most rare earth ions do not also have broad absorption bands in suitable regions of the spectrum. Consequently, the exciting lamp radiation is frequently utilized in an inefficient manner. For this reason, other species with the desired absorption spectra have been added to the laser material in the hope that the second dopant would transfer some of the energy it absorbs to the rare earth ion, thus "sensitizing" the rare earth emission. With the exception of systems in which rare earth ions are chelated to organic compounds and the latter acts as the sensitizer, this scheme has not generally proven useful in laser systems.

There is currently a strong interest in rare earth chelates. Two of the more serious problems encountered with these systems are (i) the variation with temperature of the refractive index of the solvent in which the chelates are dissolved and (ii) the difficulty of producing a nearly uniform absorption strength throughout the volume of the laser cell. Because several joules of energy are absorbed by the chelate and its solvent during the laser pulse, a fairly large temperature increase occurs. This increase produces a significant change in the refractive index and distorts the laser beam. E. P. Riedel and R. Charles (Westinghouse Research Laboratories) proposed solving this difficulty by using as the solvent heavy water at 8°C, just above the freezing point. At this temperature the refractive index varies by only 10^{-5} for a temperature variation of 4°C.

The laser cell must contain enough rare earth ions to provide sufficient amplification of the laser signal. This amplification then fixes the chelate concentration and the strength of the absorption due to the organic molecules, at a value that is usually too large to permit the exciting radiation to penetrate to the center of the laser cell. Reidel and Charles propose to solve this problem by adding a second sensitizing species (sodium *p*-benzoylbenzoate) which absorbs in a different spectral region. The concentration of this sensitizer can be varied independently from that of the chelate.

Sensitization studies of rare earth ions in glasses were described by N. T. Melamed (Westinghouse) and Shigeo Shionoya (University of Tokyo). Melamed sensitized Nd^{+3} with Mn^{+2} and Shionoya sentitized Tb^{+3} with Ce^{+3}. W. W. Anderson (Stanford University) discussed host sensitization in ZnS:Tb.

Although the emphasis of the meeting was on preparation of materials, there were a few very interesting papers on subjects related to laser characteristics and applications. John Armstrong (IBM) summarized the studies of nonlinear optical properties of materials which have been performed with laser sources. His recent work in this area has been the study of the reversible bleaching of pthalocyanine dyes. This bleaching may be applied to the shutter action in high-power optical systems, such as Q-switched lasers. The observed bleaching occurs because the intense laser beam depopulates the ground state of the pthalocyanine molecule and populates an excited state to the extent that the absorption nearly disappears. Armstrong observes increases in the transmission by several factors of ten and obtains maximum transmission approaching 100 percent as the intensity of the transmitted beam increases.

Another important development that may eventually find application was described by S. K. Kurtz and co-workers (Bell Telephone Laboratories). They have found that a comparatively large change in the refractive index of the perovskite paraelectric, potassium niobate-tantalate can be produced by the lattice polarization induced by an applied electric field. The index change can be as large as 0.007. In principle one should be able to construct from this material a prism in which an applied electric field could deflect a transmitted beam of light such that a projected spot would be moved by 160 times its diameter at a frequency as high as the microwave range.

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Water Supply and Pollution Control

Among the environmental health problems considered at the American Medical Association Congress (Chicago, Illinois, 1–2 May 1964) was that of water supply and pollution control. Four physicians and a sanitary engineer participated in the discussion.

Harold M. Erickson (deputy director, California Department of Public Health) optimistically indicated that our water pollution problems can be solved by current knowledge and techniques, but simultaneously warned that maintaining the status quo is not sufficient for the future. In tracing the history of water pollution control he noted that early efforts were directed primarily toward preventing such diseases as cholera, typhoid fever, and the dysenteries. The problem became more complex with the development of industry and the appearance of organic wastes which differ markedly from domestic sewage. Today, with population growth and accelerating demands for water, the great need is to provide for the reuse of water on an increasing scale. Erickson defined water pollution as "water quality impairment." He discussed ground and surface water pollution and considered organics, natural and artificial, radiation, and biological agents of various kinds. The consequences of pollution from the health, recreational and economic points of view were included.

In discussing the relation of water pollution to health, Charles L. Wilbar (Secretary of Health, Pennsylvania) pointed out that the United States has, for the most part, been free of waterborne epidemics. He singled out infectious hepatitis as a current problem and cited, as causes of the disease, a defective public water supply in one case and some of the clams of Raritan Bay in another case. Wilbar spoke of the work being done by the U.S. Public Health Service at the Taft Sanitary Engineering Center (Cincinnati, Ohio) on enteric viruses in primary and secondary sewage treatment. Gastrointestinal illnesses and their relationship to the sanitary quality of the water supplies in six Rocky Mountain communities were discussed as a good effect-versus-cause case. Sewage, pesticides, organics, and radioactive materials were mentioned as unsolved problems. A specific example is goiter in India which occurs at a higher rate in downstream villages than in upstream ones. Methemoglobinemia in infants who are given water from shallow contaminated wells is a possible hazard. Detergents and phosphates were also mentioned as possible problems. Wilbar recognized the fact that, although health is the most important item, water pollution control is justified because of its effect on recreation, industry, and agriculture. He concluded with a series of suggestions for practicing physicians to follow in order to ensure proper water supplies.

Russell E. Teague (Commissioner of Health, Kentucky State Department of Health) discussed local and multistate water pollution control programs. He reviewed a typhoid fever outbreak, and indicated that there were many cases of infectious hepatitis from water, and contamination of water by enteroviruses. With respect to such diseases and contamination, Teague said that they can be engineered out of the environment; this remark was a direct answer to the challenge of the entire congress. Disciplines and the costs to the people of an area and to its industry and government were presented. He pointed out that although government provided funds for reducing pollution, it commonly failed to provide funds to secure supplementary and necessary water supply of good quality. The functions of cities, states, interstate agencies, and the federal government were reviewed.

Regional water pollution control resources were discussed by the sanitary engineer member Curtis M. Everts (director, Pacific Northwest Water Laboratory, U.S. Public Health Service, Corvallis, Oregon). Everts indicated that staff, facilities, collection of data, provision of a comprehensive plan to prevent and control pollution, a good information program, research, and enforcement all are necessary to solve water pollution problems. Activities of the Public Health Service water pollution control surveillance system, the functions of the Corps of Engineers, the Bureau of Reclamation, and the Department of Health, Education, and Welfare were described. Gap areas of knowledge involving synthetic organic pesticides and other synthetic organics were mentioned. Also noted was the advanced waste treatment projects of the Public Health Service in which newer methods of waste treatment are being explored in cooperation with industry. The new and proposed field laboratories of the Department of Health, Education, and Welfare and the Taft Sanitary Engineering Center were cited as facilities that are making or are about to make important contributions to the solution of water supply problems. Everts felt that the art of presenting a case for clean streams to the public has improved tremendously during the last few years. This is shown by the high degree of collaboration secured from cities and industries faced with possible enforcement actions.

Present and future technical problems were discussed by Gaylord W. Anderson (director, School of Public Health, University of Minnesota). He traced the change in responsibility from the personal to the collective effort that is needed to assure good water supplies. More than this he emphasized the current situation as requiring the adaption of the environment to man. Quantity and quality of water are inseparable; reuse is mandatory; cleanup after each use is essential. We must continue to work on three fronts: (i) the effect on man of chemical and biologic contaminants in water, (ii) the prevention of undesirable or potential-