Optica Applicata, Vol. IX, No. 2, 1979

Meeting Report

The second national symposium "Optical fibers and their applications", Jabłonna (Poland), 13-15th Feb. 1979

Continuing the traditional meetings set up three years ago, the Second National Symposium on "Optical Fibres and their Applications" was held at Jabłonna Palace near Warsaw, on February 13 to 15 of 1979.

The Symposium has been organized jointly by the Electronics and Telecommunication Committee of the Polish Academy of Sciences (PAS), and the Institute of Telecommunications, with the co-operation of the Technical University of Warsaw, Unitra-Electron Group, Association of Polish Electrical Engineers, Technical Military Academy and the Polish Section of the IEEE. The chairman of the Symposium and its chief organizer was prof. Adam Smoliński, a member of PAS, who initiated the scientific and technical activity in the field of optical fiber communication in this country.

The purpose of the symposium was to acquaint its 200 participants, from all over the country, with the state of the art in the field of optical fibres, as well as to present results obtained in domestic laboratories during the time that has passed since the First Symposium held in 1976. The aim has been reached with the aid of 15 foreign specialists in the field, from 8 countries, who presented their papers in the course of the two-day plenary session. Results obtained in laboratories of this country have been reviewed by their authors in short communications.

The opening address was given by a member of PAS Prof. Janusz Groszkowski, a honorary chairman of the Electronics and Telecommunication Committee of PAS. This was followed by a lecture entitled "Optical fibres— possibilities of application and strategy of the development" given by the Minister of Telecommunications Prof. Edward Kowalczyk. The opening session was closed with a lecture "Technical maturity of optical fibres" by Prof. Adam Smoliński, a member of PAS. The speakers have stressed the significance of the new technique in general progress in telecommunication in view of its technical and economical advantages.

The plenary sessions of the first 2 days of the Symposium were fully occupied by the lectures delivered by the invited foreign speakers. Most of them have given an opportunity to acquaint the listeners with the state of the art in the field of optical fibres in their countries. Physical principles of the fabrication technology and requirements imposed on the starting materials which are necessary to get the desired properties of the fibres have been considered (Prof. M. E. Zabotinski, Acad. of Sciences, USSR). The fabrication process, as developed in the CNET laboratories, has been described in greater detail by Dr. A. Regreny (France). The fibres have been designed for long range communication systems. Flame hydrolysis and modified chemical and vapour deposition methods have been used in their production. The author described parts of the drawing apparatus and analysed variables of the process, like temperature and speed of the drawing which affect the quality of the fibres. The problem of obtaining a sufficient fibre strength is receiving presently significant attention, as may be inferred from the paper presented by Dr. J. A. Olszewski (General Cable Corp., USA). Low loss and high bandwidth have already been reached by US cable industry and at stake is the service life of the cables. Therefore a significant attention is being paid to the problems of proper coating of the fibre surface with various types of thermoplastic materials as well as considerable number of thermosetting materials. Experiments with metal coatings are in progress with some degree of success. The poorly coated or buffered fibers vary greatly in strength along their lengths. This shortcoming may be improved by adoption of a fiber tape laminate. Optimization of the cable structure is still a subject of research, but many successful designs have already been proposed for particular applications. Perhaps the best example of current concerns and trends is represented by installation made in Chicago in 1977 by the Bell System Co. The cable in this installation employed

24 graded-index fibers which were laminated in 2 rows of 12 fibers each and formed into a rectangular cross-section. The strength member was in the sheathing. The cable was pulled into a 2.5 cm diameter plastic duct which was previously installed in the existing standart ducts. Topics related to measurement technique of optical fibres were discussed by Prof. B. Daino (Fundatione Ugo Bordoni, Italy), and some of the measurements carried out in the Technical Research Centre of Finland have been described by Dr. M. Leppihalme. The attenuation measurements of step – and graded – index optical fibres at long wavelengths have been performed using large area Ge Schottky barrier photodetector, while the refractive index profiles in that wavelength range were studied by near field scanning method. At shorter wavelengths the Rayleigh back-scattering technique was used to measure the attenuation of the fibre and fibre joints. The scanning electron microscope or electron microprobe was applied to analyse the doping material within the cross-section of the fibre, and optical planar waveguides were studied by the mode analysis using the prism coupling method. The apparatus used for optical fibre measurements was described in more details by Dr. A. B. Sharma (Helsinki University of Technology, Finland).

Transmission properties of the eliptical fibres have been estimated in the paper presented by Prof. A. M. Scheggi (Instituto di Ricerca sulle Onde Elettromagnetiche del CNR, Italy).

Although fabrication technology of such fibres may turn out to be difficult, it can be of interest because they provide a better match to injection lasers and edge emitting LED'S.

The well known fact, that the fibre has a very-low-loss window at 1.3 μm and the material dispersion of the glass constituents falls to zero near 1.3 μm attracts a growing attention. A paper by Dr. D. N. Payne (University of Southampton UK) was devoted to this problem. The author has reviewed the wavelength dispersive effects and measurements of both profile and material dispersion parameters taken over a wide range of wavelength, and for a variety of compositions and fibres made by CVD process.

As the question, how fast the optical fibre communication will become a reality, still remains to be answered, a particularly keen interest has been aroused by Dr. J. E. Midvinter's talk (Post Office Research Centre, UK). Its major part was devoted to description of the field trials that have been carried out in UK. They were started in May 1977, to built an 8 Mbit/s link that runs a distance of 13 km from the Centre to the Group Switching Centre in Ipswitch. The system operates with laser transmitters without an intermediate repeater and with one intermediate repeater when using LED transmitters. A second system presently 8 km long and running in parallel with the above link, operates at 140 Mbit/s. One month later, STC installed a repeater 140 Mbit/s system over a 9 km route from Stevenage to Hitchin. A number of other 8 Mbit/s links are being installed. It is interesting to note that GEC have achieved in laboratory a repeater spacing of 17 km at 8 Mbit/s with an LED source by using fibre with a loss substantially less than 3 db/km at 900 nm.

Even more impressive are the considerations about the future systems in UK. The loss and the material dispersion of the silica glass fibre, both are encouraging to think of system operation in the 1.3 and 1.6 micron wave band. The very low loss that, in principle, can be obtained at these wavelengths leads naturally to thoughts of exceptionally long repeater spacings in the 50 up to 100 km range, with consequent implications for the layout of the transmission network.

Equally interesting results have been achieved in West Berlin, as one could learn from the paper presented by Dr. Feldmann (Forschungsinstitut der Deutschen Bundespost, Aussenstelle West Berlin). The experimental 34 Mbit/s link was built there two years ago and has been operating since then with no major technical problems. A very carefully designed experiment has proved that optical fibre systems are fully suitable for telephone communication in difficult conditions of a densly populated urban area.

Although major attention is presently concentrated on long range optical transmission systems, opportunities offered by optical fibres to low information rate communication links over short distances should not be neglected. They can be used as data transmission systems or serve for purposes of remote control. In both cases a major driving force is the possibility of providing low cost equipment which is free of ground loop and interference problems. Requirements imposed on optical fibres used in such applications have ben considered by L. V. Levkin (Acad. of Sciences, USSR).

Optical fibres can also offer new opportunities in fields other than optical communication. These have been reviewed by Dr. A. L. Harmer (Battelle Research Centre, Switzerland) in his speech concerning optical fibre transducers for optical instrumentation systems. These systems employ passive optical transducers to measure physical variables, connected by fibre optics to a light source and photodetector or control unit. There are two areas where such systems are potentially competitive against current electronic systems. First — higher performance systems, particularly for interferometric devices where the optical system is more sensitive than its electronic or mechanical counterpart. Second — industrial systems operating in hostile enviroments where high levels of electromagnetic interface, high voltages, elevated temperatures or high fire risk reduce electronic system rehability and render them difficult and costly to operate. Various types of transducers have been described and their performance discussed.

With the above paper the second day plenary sessions were closed leaving the third day of the Symposium entirely devoted to short communications in which results obtained in laboratories of this country were presented. There were altogether 46 papers presented in two sections running in parallel. It has to be emphasized that a significant progress has been made during the time that has passed since the First Symposium held three years ago.

That may be concluded not only from the number of registered communications but also from the cross-section of the problems that have been dealt with. Of particular interest were communications describing results collected in the course of work on the optical fibre link that has been installed for the first time in this country. This link operates at 1.544 Mbit/s and runs a distance of over 2.5 km between two telephone exchanges in Lublin. The system was tried on the very day when the Second Symposium was opened and thus the beginning of the new era of optical communication in this country will be easy to recall. Optical fibres used in the experimental system are a graded index silica core type obtained in a CVDM process. Coated for protection with a silicon clading they were afterwards formed into a 4 fibre cable with 2 metal members in the sheathing to secure proper strength. As an optical signal source a GaAs LED was employed and in the receiver circuit a silicon avalanche photodiode was used. The optical system operated in the 1B2B code, while the existing telephone network operating in the TCK-24 mode required the AMI code. Therefore a special coder and decoder circuits have been developed. It has to be mentioned that in this complex work a number of research groups have been engaged under the leadership of Prof. Zenon Szpigler.

The LED'S and photodetectors used in the experimental optical fibre link have been described in separate papers which were followed by some other papers on semiconductor lasers and photodetectors. A pulse generator, suitable to drive lasers has also been described.

Many other works related to optical fibre communication systems have been presented. Among them electronic circuits for a 8448 kbit/s system was discussed. In this system an ordinary large area LED and p-i-n photodiode were used. Requirements for transmission codes in optical fiber systems and basic parameters of the optical signals in those codes have been analyzed.

Other communications were concerned with technology of optical fibres drawn by double crucible method or plasma heating. A method of fibre cleaving and a suitable apparatus have been described.

It should be admitted that a significant progress has been also made in optical fibre measurements. Over 7 communications have been devoted to this problem. Methods of the index profile measurement based on the near field analysis and interference pattern have been described. Systems for measurement of the fibre attenuation at different wavelengths employing transmission methods have been developed.

A number of works on the dispersion problems in multimode fibres have been presented and an optimization of the index profile to reduce this effect has been discussed.

Another group of communications was concerned with integrated optics components. Results achieved in the technology of planar dielectric waveguides formed by ion exchange and by deposition of thin SiO_x or organic layers on a glass substrate have been reported. A number of physical phenomena encountered in planar waveguides have been investigated. One can mention here propagation properties of monochromatic surface waves in a planar waveguide with a variable impurity profile, coupling between a prism and an anisotropic waveguide, or an effect of some incident changes in the direction of optical axis in the anisotropic waveguide on the mode coupling and power losses due to light emission.

Measurement techniques of planar waveguides have also been investigated. Index profile was deduced from measurement of synchronic angles and attenuation was estimated by measurement of the light extracted or dispersed from the waveguide.

Finally, the last but not the least important group of papers was involved with optical fibres applications in the fields other than optical communication. Results of research on optical delay lines have been presented here. These lines featured a very high delay — bandwith product and found application in optical radar data processing systems.

Optical fibres have been also employed in the switching circuits of silicon controlled rectifiers connected in series, that helped to solve the problem of electrical isolation between the SCR's and the control circuit.

Very important advantages can be offered by optical fibres to ophthalmology. They can be used in surgical instrumentation or diagnosis and measurements. An interesting optical fibre model of a human retina has been proposed. In a sense, similar application have been found by biologists who tried to use optical fibres for sudying vital processes in conifer buds.

Planar waveguides can be used to estimate the state of the surface of a superfine polished optical glass. Here, the properties of a monomode planar waveguide that has been formed on the glass surface by deposition of a thin SiO_x layer are checked.

Review of the papers presented at the Symposium leaves little doubt about the significance of optical fibres in various fields of modern technology and communication systems in particular. In more details this will be shown in the proceedings from the Symposium that are due to appear not later than at the beginning of the next year.

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The Scientific Secretary
of the Symposium