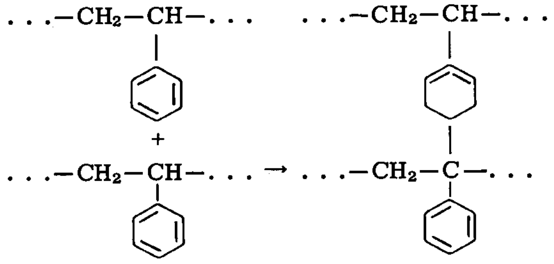
x-rays, protons, deuterons, alpha-particles, fission fragments, and the general laws of the radiation chemistry of high polymers.

The radiochemical processes in the formation and various properties of polymers are discussed in their various aspects—such as cross-linking, degradation, solubility, molecular weight, liberation of gas, oxidation, physical properties, crystallinity, thermal expansion, electrical and mechanical characteristics, strength and elongation, permeability to gases, and the modulus of elasticity.

Examples of the type of coverage are: Polyethylene is the simplest polmer cross-linked by irradiation and consequently is characteristic for all polymers so cross-linked. The valuable properties acquired by polyethylene are increase in electrical stability at higher temperatures, and corrosive stability—for example, 100% H_2SO_4 and aqua regia oxidize only its surface. Its resistance to stress cracking and to chemicals is considerably increased. Its rubbery state and resistance to melting at higher temperature makes it useful in the manufacture of vessels for medical, pharmacological and food sterilization. It has maximum tensile strength 125-225 kg/cm^2; modulus of elasticity 1250-1400 kg/cm^2; percent elongation at breakage point 500-600; hardness R11; specific gravity 0.92; negligible water absorption; good stability in acids (except nitric) and in bases and in solvents below 60 C but swells in hydrocarbons and their Cl-derivatives at 60-100 C; resistance to aging in open air—should be protected from sunlight.

The presence of phenyl rings in polystyrene gives it high radiation stability. The doses necessary for its cross-linking are 1.5 to 2 times higher than those for polyethylene and rubber. Cross-linking is the predominant process in the irradiation of polystyrene but it does not ensue for some time after irradiation begins and degradation is first dominant. The hypothesis has been made that the phenyl group participates in the cross-linking and that hydrogen is not liberated, as:



Cross-linking begins to influence polystyrene even when only 0.6 bonds per molecule have been formed. Such samples retain their form and will not melt at 250 C. When three bonds are formed per each 100 monomers, the modulus of elasticity increases with rise in temperature of vitrification.

The author's general conclusions are: The analysis of the data shows that irradiation of high polymeric substances is accompanied by profound changes of the entire conglomerate of their properties. The basic directions of radiochemical processes in polymers—cross-linking or degradation—are uniquely determined by the nature of the polymer. However, a number of polymers exist in which both of these processes are equally probable.

The irradiation conditions (temperature, dose strength, phase relations in the polymer) are of secondary importance, and their effect is not sufficiently known at the present time.

Further studies in this direction will give a better understanding of the radiochemical processes taking place both in polymers and in other classes of chemical compounds and will permit the practical employment of ionizing radiation in the field of high polymeric materials.

This review covers the literature published in the USSR and abroad up until the end of 1958.

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About the Reviewer: Samuel C. Lind is now a consultant at the Oak Ridge National Laboratory. He was born in 1879; he received his Ph.D. degree at the University of Leipzig in 1905 and 4 honorary D.Sc. degrees since then. In his academic life he was instructor at the University of Michigan, Director of the School of Chemistry at Minnesota for 9 years and its Dean of Institute of Technology for 12. He has written three books on various phases of electrochemistry. He received the Nichols Metal Award, the Priestly Metal Award, and the Distinguished Service Award of the Minnesota Chapter of Sigma Xi. He is a member of the National Academy of Sciences, a past president of the American Chemical Society and of the Electrochemical Society, and was for 20 years the editor of the Journal of Physical Chemistry. *He fishes for trout in his spare time.*

Fracture of Solids: Proceedings of an International Conference Sponsored by the Institute of Metals Division, American Institute of Mining, Metallurgical, and Petroleum Engineers. Edited by D. C. Drucker and J. J. Gilman. Maple Valley, Washington, (August 21-29, 1962). 706 pp. $28.00.

The failure of real substances under loads far below the strength of perfect materials is an ever-present concern for design engineers and a fascinating problem for theorists. The great effort devoted to studying fracture in recent years was the justification for another International Conference on this topic. The present volume reports the proceedings of this meeting. It is of interest as a sequel to the April, 1959, meeting in Swampscott, Massachusetts.

The book consists of twenty-five papers and three notes arranged in four sections: continuum mechanics, microstructural phenomena, atomistic mechanisms, and environmental effects. The first paper in each section is meant to be a survey. The paper by Makin and Petch on atomic mechanisms is the best of these surveys. Drucker's excellent paper is rather a development of his model of a flawed, work-hardening continuum. The other two surveys are poorly organized.

The book suffers from editing flaws. It has no author or subject index. Notation is not consistent—for example, surface energy is represented by three different symbols. No discussions are presented from this meeting rich in controversial subjects—e.g., Hull's paper maintaining that twins are important in nucleating cracks in silica steel is followed, without comment, by Priestner's claiming that twins are of little significance in this material. Some of the papers are marred by clumsy rhetoric, such as, "All of these specimens were either notched, or notched and fatigued, and then broken in tension, to determine their residual strength, thus simulating the case of a fatigue crack in an aircraft skin" (page 253).

As often happens with compilations of the works of many authors, the papers vary greatly in quality. Some are of outstanding merit. Tetelman gives a definitive account of hydrogen embrittlement of ferrous alloys. Williams reports recent studies on viscoelastic materials and points out fruitful analogies between these substances and metals. His treatment of cumulative damage is particularly interesting. Marsh examines the often neglected role of surface steps in nucleating cracks and in a second paper makes an important contribution to the theory of indentation hardness measurements in highly elastic materials. Gilman considers the factors that determine cleavage planes in body-centered cubic metals. Stofel and Wood give preliminary data on non-basal slip in zinc and propose a mechanism for crack initiation during such deformations. Stokes and Li relate the direction of micro-crack extension in non-metallic crystals to local plastic constraints and derive the temperature dependence of the mode of failure. The other papers on non-metallic crystals add little to this one. Tromans and Nutting describe the relative importance of the factors contributing to stress corrosion cracking in copper and its alloys.

In the technical notes Gruntfest blazes a clear new trail exploring the effect on plastic flow of heat developed by deformation; McEvily and Boettner give an excellent analysis of the relative weakness in fatigue of precipitation-hardened alloys; but the third note is so limited as to be out of place.

A few papers besides the two surveys already mentioned are disappointing. The long paper on fatigue cracks, by Avery and Backofen, contains little not previously published. Much of the analysis in the paper on mercury embrittlement is unconvincing. Such factors as the inverse relation in non-corrosive atmospheres between strength and grain size and the variation in segregation of impurities during the different heat treatments used in sample preparations are neglected. Few but the authors of this paper who write, "Several interesting characteristics are observed: (1) as prestrain in air increases, subsequent strain to fracture in mercury decreases at all grain sizes" will find that characteristic interesting.

For this reviewer, too much emphasis was placed on continuum attempts to explain fracture, an atomic process. Much of this work, such as Goodier and Field's on energy dissipation in crack propagation, appears to be done in isolation. Their abstract paper is contrasted in this volume with Tetelman's extension of Friedel's crack dislocation model, to where he could make and test quantitative predictions.

This book contains much of interest, but its worth is diminished by poor organization. Much of the value of a conference is lost to readers when the interchange of thoughts amongst the conferees in the discussions is not presented. This expensive vehicle does a poor job of conveying its valuable cargo.

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