

Sixty-third Annual Meeting Papers

PROPERTIES OF
CRYSTALLINE SOLIDS



Published by the
AMERICAN SOCIETY FOR TESTING MATERIALS
1916 Race St., Philadelphia 3, Pa.

ASTM Special Technical Publication No. 283

PROPERTIES OF CRYSTALLINE SOLIDS

[Materials Sciences Luncheon Address
Symposium on Recent Progress in Materials Sciences
Symposium on Nature and Origin of Strength of Materials]

Presented at the

SIXTY-THIRD ANNUAL MEETING

AMERICAN SOCIETY FOR TESTING MATERIALS

June 27, 1960



Reg. U.S. Pat. Off.

ASTM Special Technical Publication No. 283

Price \$4.00; to Members \$3.20

Published by the
AMERICAN SOCIETY FOR TESTING MATERIALS
1960 Race St., Philadelphia 3, Pa.

© BY AMERICAN SOCIETY FOR TESTING MATERIALS 1961

Library of Congress Catalog Card Number: 61-9308

Printed in Baltimore, Md.

February, 1961

FOREWORD

The first public effort of the Society's Division of Materials Sciences was the sponsorship of two symposia held on June 27, 1960, at the Sixty-third Annual Meeting of the Society. For the first session, "Recent Progress in Materials Sciences," arrangements were made by ASTM President Frank L. LaQue (1959-1960), J. H. Koenig, and I. V. Williams. President LaQue and Mr. Williams presided at the session.

For the second session, "Nature and Origin of Strength of Materials," arrangements were made by ASTM Vice-President A. Allan Bates, assisted by Mr. John D. Sullivan. Dr. Bates and Mr. Sullivan were co-chairmen for this session.

General plans for the two symposia were made by a Steering Committee for organization of the new Division of Materials Sciences, comprising K. B. Woods, Chairman, A. Allan Bates, M. N. Clair, W. L. Fink, J. H. Koenig, Richard T. Kropf, F. L. LaQue, John Sullivan, A. C. Webber, and I. V. Williams. The formal organization of the Division of Materials Sciences took place following the second session.

In addition to the eight papers from the two symposia, the Symposium volume includes an introductory paper by W. O. Baker, Vice-president—Research, Bell Telephone Laboratories. Dr. Baker's paper, which was based on an address presented at the Materials Sciences Luncheon held at noon on the day of the symposia, outlines the national role of materials research and places in perspective the Society's current interest in the science of materials as complementary to its long-standing interest in standards for materials.

In combining the two materials science symposia in a single volume, we have chosen as a title for the book "Properties of Crystalline Solids." While the subject of the first symposium may seem even broader, it will be seen that all the papers deal with solids and especially crystalline solids.

Later symposia to be sponsored by the Division may be expected to deal with all states of matter—solids, liquids, gases, plasmas—as they illustrate fundamentals and are of interest in the broad field of materials.

One final word of commendation is in order for those, who, in addition to the authors, not only have made this program possible, but who are responsible for its great success. Our thanks for the excellent planning and execution of these symposia go to the program committee, Messrs. Bates, Koenig, Sullivan, and Williams, ably encouraged and abetted by ASTM President Frank LaQue.

K. B. WOODS, *Chairman*
Division of Materials Sciences

NOTE.—The Society is not responsible as a body, for the statements
and opinions advanced in this publication.

C O N T E N T S

	PAGE
The National Role of Materials Research and Development—W. O. Baker.....	1
Symposium on Recent Progress in Materials Sciences	
Accomplishments and Limitations of Solid State Theory—Harvey Brooks.....	11
The Influence of Surfaces on the Properties of Materials—M. J. Sinnott.....	28
Mechanical Properties of Semiconductors—John N. Hobstetter.....	40
Status of Ductile Ceramic Research—Earl R. Parker.....	52
Symposium on Nature and Origin of Strength of Materials	
Dislocation Motions and the Yield Strength of Solids—John J. Gilman.....	69
Discussion.....	81
Resistance to Creep Deformation and Fracture in Metals and Alloys—F. Garofalo..	82
Discussion.....	98
Brittle Fracture Strength of Metals—E. T. Wessel.....	99
Discussion.....	116
Effects of Size and Shape on Fracture of Solids—G. R. Irwin.....	118
Discussion.....	128
Fatigue Strength of Crystalline Solids—G. M. Sinclair and C. E. Feltner.....	129
Discussion.....	141
<hr style="width: 10%; display: inline-block; vertical-align: middle;"/>	
Appendix: Editor's Notes on Crystal Physics Terminology.....	143

THIS PUBLICATION is one of many issued by the American Society for Testing Materials in connection with its work of promoting knowledge of the properties of materials and developing standard specifications and tests for materials. Much of the data result from the voluntary contributions of many of the country's leading technical authorities from industry, scientific agencies, and government.

Over the years the Society has published many technical symposiums, reports, and special books. These may consist of a series of technical papers, reports by the ASTM technical committees, or compilations of data developed in special Society groups with many organizations cooperating. A list of ASTM publications and information on the work of the Society will be furnished on request.

