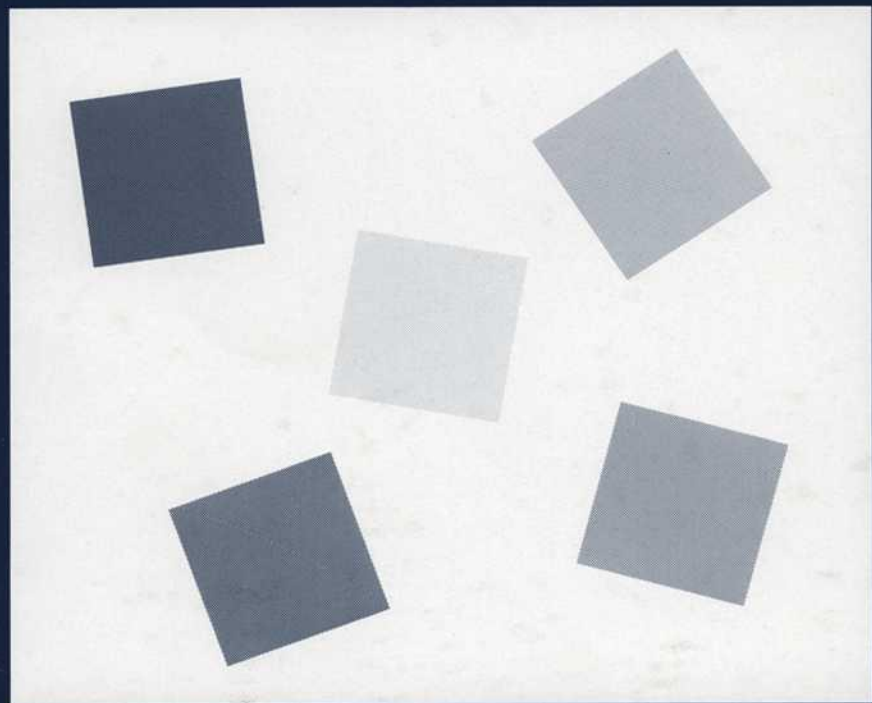


Assignment of the Glass Transition



Rickey J. Seyler, editor



STP 1249

STP 1249

Assignment of the Glass Transition

Rickey J. Seyler, Editor

ASTM Publication Code Number (PCN):
04-012490-50



ASTM
1916 Race Street
Philadelphia, PA 19103

Printed in the U.S.A.

Library of Congress Cataloging-in-Publication Data

Assignment of the glass transition / Rickey J. Seyler, editor.

(STP ; 1249)

"ASTM publication code number (PCN): 04-012490-50."

Includes bibliographical references and index.

ISBN (invalid) 0-8081-1995-X

I. Seyler, Rickey J., 1950- . II. Series: ASTM special technical publication ; 1249.

IN PROCESS

641.8'23—dc20

94-27245

CIP

Copyright © 1994 AMERICAN SOCIETY FOR TESTING AND MATERIALS, Philadelphia, PA. All rights reserved. This material may not be reproduced or copied, in whole or in part, in any printed, mechanical, electronic, film, or other distribution and storage media, without the written consent of the publisher.

Photocopy Rights

Authorization to photocopy items for internal or personal use, or the internal or personal use of specific clients, is granted by the AMERICAN SOCIETY FOR TESTING AND MATERIALS for users registered with the Copyright Clearance Center (CCC) Transactional Reporting Service, provided that the base fee of \$2.50 per copy, plus \$0.50 per page is paid directly to CCC, 222 Rosewood Dr., Danvers, MA 01923; phone: (508) 750-8400; fax: (508) 750-4744. For those organizations that have been granted a photocopy license by CCC, a separate system of payment has been arranged. The fee code for users of the Transactional Reporting Service is 0-8031-1995-X/94 \$2.50 + .50.

Peer Review Policy

Each paper published in this volume was evaluated by three peer reviewers. The authors addressed all of the reviewers' comments to the satisfaction of both the technical editor(s) and the ASTM Committee on Publications.

The quality of the papers in this publication reflects not only the obvious efforts of the authors and the technical editor(s), but also the work of these peer reviewers. The ASTM Committee on Publications acknowledges with appreciation their dedication and contribution to time and effort on behalf of ASTM.

Foreword

This publication, *Assignment of the Glass Transition*, contains papers presented at the symposium of the same name, held in Atlanta, GA on 4-5 March 1993. The symposium was sponsored by ASTM Committee E-37 on Thermal Methods in celebration of its 20th anniversary with the cooperation of the Plastics Analysis Division of the Society of Plastics Engineers (SPE-PAD) and the North American Thermal Analysis Society (NATAS). Rickey J. Seyler, Eastman Kodak Company, served as chairman of the symposium and is editor of the resulting publication.

Contents

| | |
|--|---|
| Overview | 1 |
| Audience Discussion I: Dealing with Condensed Moisture—R.P. TYE | 4 |
| Audience Discussion II: Measurement of Temperatures and the Precision of the Assigned Glass Transition Temperature—R.P. TYE | 6 |

THEORY AND OVERVIEW

| | |
|---|-----|
| Opening Discussion—R.J. SEYLER | 13 |
| The Nature of the Glass Transition and Its Determination by Thermal Analysis—B. WUNDERLICH | 17 |
| Phenomenology of the Structural Relaxation Process and the Glass Transition—C.T. MOYNIHAN | 32 |
| Glass Transition Measurements by DSC—H.E. BAIR | 50 |
| Assignment of Glass Transition Temperatures Using Thermomechanical Analysis—C.M. EARNEST | 75 |
| The Application of Dynamic Mechanical Methods to T_g Determination in Polymers: An Overview—R.P. CHARTOFF, P.T. WEISSMAN, AND A. SIRCAR | 88 |
| Assignment of the Glass Transition Temperature Using Dielectric Analysis: A Review—S.A. BIDSTRUP AND D.R. DAY | 108 |
| Discussion | 118 |
| Calorimetric Studies on Glasses and Glass Transition Phenomena—S.-S. CHANG | 120 |
| Discussion | 136 |
| Analysis of DSC Thermal Curves for Assigning a Characteristic Glass Transition Temperature, Dependent on Either the Type or Thermal History of the Polymer—J. R. SAFFELL | 137 |

INSTRUMENTAL TECHNIQUES

| | |
|---|-----|
| Sensing Glass Transitions in Thin Polymer Films on Acoustic Wave Microsensors—J. W. GRATE | 153 |
| Plasticization of Polystyrene by High Pressure Gases: A Calorimetric Study—M. L. O'NEILL AND Y. P. HANDA | 165 |

| | |
|--|-----|
| Glass Transition in Polymers: Comparison of Results from DSC, TMA, and TOA Measurements—H. G. WIEDEMANN, G. WIDMANN, AND G. BAYER | 174 |
|--|-----|

MATERIALS

| | |
|---|-----|
| Glass Transition and Heat Capacities of Inorganic Glasses: Diminishing Change in the Heat Capacity at T_g for $x\text{Na}_2\text{S} + (1 - x)\text{B}_2\text{S}_3$ Glasses—J. KINCS, J. CHO, D. BLOYER, AND S. W. MARTIN | 185 |
| Glass Transition of a Liquid Crystal Polymer—B. CASSEL AND A. T. RIGA | 202 |
| Discussion | 212 |
| Glass Transition(s) of Ionomers—R. A. WEISS | 214 |
| Measurement of the Glass Transition Temperature of Elastomer Systems—A. K. SIRCAR AND R. P. CHARTOFF | 226 |
| Assigning the Glass Transition Temperature in Oriented Poly(ethylene terephthalate)—M. J. MOSCATO AND R. J. SEYLER | 239 |

APPLICATIONS

| | |
|--|-----|
| The Glass Transition Temperature of Glassy Polymers Using Dynamic Mechanical Analysis—E. L. RODRIGUEZ | 255 |
| Measuring the Glass Transition Temperature of EPDM Roofing Materials: Comparison of DMA, TMA, and DSC Techniques—R. M. PAROLI AND J. PENN | 269 |
| Evaluation of Upper Use Temperature of Toughened Epoxy Composites—J. L. JANKOWSKY, D. G. WONG, M. F. DiBERARDINO, AND R. C. COCHRAN | 277 |
| Glass Transition Measurements on Automotive Coatings by DSC, DMA, and TMA—M. K. GUPTA | 293 |
| Discussion | 301 |
| Closing Discussion: Highlights and the Challenges that Remain—R. J. SEYLER | 302 |
| Author Index | 305 |
| Subject Index | 307 |

ISBN 0-8031-1995-X