

The Complete Book on Glass Technology

Author: NPCS Board of Consultants & Engineers

Format: paperback

Code: NI205

Pages: 584

Price: Rs 1625 | US\$ 150

Publisher: NIIR PROJECT CONSULTANCY SERVICES

Shipping: 5 days

About the Book

Glass is an amorphous solid usually formed by the solidification of a melt without crystallisation. It is an inorganic product of melting, which has been cooled to rigid state without crystallization. Melting is in fact the sole large scale industrial method of glass making. Glass is being used worldwide and has various applications. They are typically brittle and optically transparent. It is widely used in buildings and having industrial applications. The presence of glasses in our everyday environment is so common that we rarely notice their existence. Glass, as a substance, plays an essential role in science and industry. There are various methods of glass making other than melting for example condensation of vapours, conversion of crystals to an amorphous form using mechanical means or irradiation with fast neutrons, dehydration and sintering of gels, etc. Silica (the chemical compound SiO_2) is a common fundamental constituent of glass. The properties of glass can be varied and regulated over an extensive range by modifying the composition, production techniques, or both. In any glass, the mechanical, chemical, optical, and thermal properties cannot occur separately. Instead, any glass represents a combination of properties, and in selecting an individual glass for a product, it is this combination that is important. As an architectural element, glass has become the quite essential product for your home or building. The applications of glass are limited only by your imagination; glass has many applications both internal and external that play a vital role in the function and design of your project. Industrially produced glasses can be divided into groups according to various criteria: composition, appearance, properties, application, method of forming etc. According to their chemical composition glasses are classified as silica glass (quartz glass), water (soluble) glass or sodium silicate glass, crystal glass, heat resistant glass, low alkali glass etc. Glass is finding ever wider applications in modern technology; sealing glasses which have been in use for many years, serve in vacuum tight joining of glass to metal, especially in vacuum electronics, in nuclear technology (protection from radiation, immobilization of radioactive waste by fusion into a chemically, resistant glass, etc.), in agriculture (as carrier of fertilizers with long term effects) and a number of possible application in electronics and many more.

Some of the fundamentals of the book are structure of glass, structure of special melts and glasses, composition of glass, glass formation, crystallization and liquid, optical properties, theoretical strength of glasses, practical strengths of glasses, flaw sources and removal, viscosity of glass forming melts, theoretical principles of glass melting, chemical reactions occurring in glass melting, dissolution of solids in the melt, flow of glass in melting furnaces, physical chemical factors in sol gel processing, deposition of transparent non crystalline, metal oxide coatings by the sol gel process etc.

The present book covers different important parameters of glass technology. The book is comprehensive guide for researchers, technologists, new entrepreneurs and professionals.

Contents

1. GLASS

Definition and Historical Summary

Structure of Glass
Structure of Special Melts and Glasses
Composition of Glass
Glass Formation, Crystallization and Liquid Immiscibility
Chemical, Mechanical and Physical Properties of Industrially Important Melts and Glasses
Rheological Properties of Glass Melts
Surface Tension
Density
Thermal Expansion
Elastic Properties
Mechanical Strength
Hardness
Thermal Properties
Electrical Properties
Gas Permeability
Chemical Stability and Surface Properties
Optical Properties
Color of Glasses
Production of Glass
Raw Materials
Melting Units
Melting, Fining and Homogenization
Glass Cooling
Heating and Regulating Glass Melts
Refractory Lining of Melting Units
Vapor-Deposited Glasses
Occupational Health
Forming
Hand Forming
Annealing
Secondary of Finishing Operations
Uses
Silica and Silica-like Glass
Flat Glass
Laboratory Glassware
Light-Sensitive Glass
Display Devices
Glass Fibers
Molded Optics
Glasses for Nonlinear Optical Devices
Economic Aspects
2. OPTICAL PROPERTIES
Introduction
Bulk Optical Properties
Refractive Index
Molar and Ionic Refractivities
Dispersion
Ultraviolet Absorption
Visible Absorption

Ligand Field Coloration of Glasses

Amber Glass

Colloidal Metal Colors

Colloidal Semiconductor Colors

Radiation-induced Colors

Solarization

Infrared Absorption

Infrared Absorption by Bound Hydrogen Species

Infrared Absorption by Dissolved Gases

Infrared Cutoffs or the Multiphonon Edge

Other Optical Properties of Glasses

Photosensitive and Photochromic Glasses

Opal Glasses

Faraday Rotation

3. MECHANICAL PROPERTIES

Introduction

Elastic Modulus

Hardness

Fracture Strength

Theoretical Strength of Glasses

Practical Strengths of Glasses

Flaw Sources and Removal

Strengthening of Glass

Statistical Nature of Fracture of Glass

Fatigue of Glasses

Thermal Shock

Annealing of Thermal Stresses

4. VISCOSITY OF GLASSFORMING MELTS

Introduction

Viscosity Definitions and Terminology

Viscoelasticity

Viscosity Measurement Techniques

Rotation Viscometers

Falling Sphere Viscometers

Fiber Elongation Viscometers

Beam-bending Viscometers

Other Viscometers

Temperature Dependence of Viscosity

Fragility of Melts

Free Volume Model for Viscous Flow

Entropy Model for Viscous Flow

Compositional Dependence of Viscosity

Silicate Melts

Borate Melts

Germanate Melts

Halide Melts

Chalcogenide Melts

Effect of Hydroxyl on Melt Viscosities

Effect of Thermal History on Viscosity

Effect of Phase Separation on Viscosity

Effect of Crystallization on Viscosity



5. STRUCTURE OF GLASSES

Glass Formation

Models of Glass Structure

The Structure of Oxide Glasses

Submicrostructural Features of Glasses

Miscibility Gaps in Oxide Systems

General Discussion

6. GLASS TECHNOLOGY

The Characteristics of Glass

Properties of Molten Glasses

Viscosity

Crystallization

Surface Tension

Density

Specific Heat

Thermal Conductivity

Electrical Conductivity

Theoretical Principles of Glass Melting

Chemical Reactions Occurring in Glass Melting

Dissolution of Solids in the Melt

Flow of Glass in Melting Furnaces

Homogenization

Volatilization

Refining and Solubility of Gases

Flat Glass and Tube-forming Processes

The Forming of Glass Fibres

Properties of Glass

Mechanical Properties

Thermal Properties

Optical Properties

Electrical Properties

Chemical Durability

Principle Types of Industrial Glasses

Silica Glass (quartz glass)

Sodium-Silicate Glass (water glass)

Sheet and Container Glass; the System $\text{Na}_2\text{O}-\text{CaO}-\text{SiO}_2$

Crystal Glass; the System $\text{K}_2\text{O}-\text{CaO}-\text{SiO}_2$ and $\text{K}_2\text{O}-\text{PbO}-\text{SiO}_2$

Heat-Resistant Glasses of the System $\text{Na}_2\text{O}-\text{B}_2\text{O}_3-\text{SiO}_2$

Coloured Glasses

Opal Glasses

Optical Glasses

Glass Fibres

Other Types of Oxide Glasses and Products

Chalcogenide Glasses

7. NITRIDATION OF SILICA SOL-GEL THIN FILMS

Introduction

Experimental Methods

Results and Discussion

Film Shrinkage

Refractive Index

SIMS Depth Profiles

Auger Analyses

Enhancing the Nitridation Reaction with a Chlorine

Pretreatment

8. MODIFICATION OF OXIDES BY POLYMERIZATION PROCESS

Introduction

Introduction of Chemical-Structural Variations in

Inorganic Polymers

Theoretical Bases

Experimental

Effect on Properties

Effect on Densification and Viscosity

Effect on Crystallization and Crystalline Transformations

9. DRYING AND FIRING MONOLITHIC SILICA SHAPES FROM SOL-GELS

Introduction

Experimental Technique

Results and Discussion

10. SOL-GEL-DERIVED INDIUM-TIN-OXIDE COATINGS

Introduction

Properties of Sol-Gel Derived ITO Coatings

Characteristic Properties of ITO-Coatings for Window-

Systems Derived from Dip Coating

Optical Properties

Architectural Properties

Mechanical Properties

Chemical Properties

Long-Term Stability, Weatherability, Outdoor Tests

Properties of an Insulating Glass Unit (One Pane ITO-
Coated)

11. RELATIONSHIPS BETWEEN THE SOL-TO-GEL AND GEL-TO-GLASS CONVERSIONS

Introduction

Gelation

Gel-to-Glass Conversion

Experimental

Results & Discussion

Physical Properties

Shrinkage and Densification

Isothermal Shrinkage Experiments

12. MONOLITHIC XERO-AND AEROGELS FOR GEL-GLASS PROCESSES

Introduction

Main Steps in Gel Processing

Cracking During the Drying Process

Analysis of Causes of Cracking

Effect of Capillary Forces

Concept of Moisture Stress

Mechanical Resistance of the Gel

Ways of Avoiding Cracking During Drying

Monolithic Aerogels

Conclusion

13. BEHAVIOR OF MONOLITHIC SILICA AEROGELS AT TEMPERATURES ABOVE 1000°C

Introduction

Densification of the Gel

Experimental Procedure

Results and Discussion

Conclusion

14. TiO₂ COATED GLASS BEADS

Introduction

Experimental

Materials

Instrumentation

Preparation of Catalysts

Hydrogenation Experiments

Results and Discussion

Features of Glass Beads Coated with TiO₂

Catalytic Activity of Pd Dispersions on TiO₂ Coated

Glass Supports

15. DEPOSITION OF TRANSPARENT NON-CRYSTALLINE METAL OXIDE COATINGS BY THE SOL-GEL PROCESS

Introduction

Dip-Coating Technique

Single-Layer Coatings with Refractive Index Gradient

Experimental Work

Results and Discussion

SiO₂-B₂O₃-Na₂O System

SiO₂-BaO System

16. PHYSICAL CHEMICAL FACTORS IN SOL-GEL PROCESSING

Introduction

Gel Synthesis

Principles of Gelation

Silica Gel

TiO₂ Gels

SiO₂-B₂O₃ Gels

SiO₂-TiO₂ Gels

Na₂O-SiO₂ Gels

Drying

The Gel-Glass Conversion

Conclusions

NIIR PROJECT CONSULTANCY SERVICES (NPCS) is a reliable name in the industrial world for offering integrated technical consultancy services. NPCS is manned by engineers, planners, specialists, financial experts, economic analysts and design specialists with extensive experience in the related industries.

Our various services are: Detailed Project Report, Business Plan for Manufacturing Plant, Start-up Ideas, Business Ideas for Entrepreneurs, Start up Business Opportunities, entrepreneurship projects, Successful Business Plan, Industry Trends, Market Research, Manufacturing Process, Machinery, Raw Materials, project report, Cost and Revenue, Pre-feasibility study for Profitable Manufacturing Business, Project Identification,

Project Feasibility and Market Study, Identification of Profitable Industrial Project Opportunities, Business Opportunities, Investment Opportunities for Most Profitable Business in India, Manufacturing Business Ideas, Preparation of Project Profile, Pre-Investment and Pre-Feasibility Study, Market Research Study, Preparation of Techno-Economic Feasibility Report, Identification and Section of Plant, Process, Equipment, General Guidance, Startup Help, Technical and Commercial Counseling for setting up new industrial project and Most Profitable Small Scale Business.

NPCS also publishes varies process technology, technical, reference, self employment and startup books, directory, business and industry database, bankable detailed project report, market research report on various industries, small scale industry and profit making business. Besides being used by manufacturers, industrialists and entrepreneurs, our publications are also used by professionals including project engineers, information services bureau, consultants and project consultancy firms as one of the input in their research.

Our Detailed Project report aims at providing all the critical data required by any entrepreneur vying to venture into Project. While expanding a current business or while venturing into new business, entrepreneurs are often faced with the dilemma of zeroing in on a suitable product/line.

NIIR PROJECT CONSULTANCY SERVICES, 106-E, Kamla Nagar, New Delhi-110007, India. **Email:** npcs.india@gmail.com **Website:** NIIR.org