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INTERNAL FRICTION AND RHEOLOGICAL BEHAVIOUR OF GLASSES NEAR Tg

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Résumé - Les principales caractéristiques expérimentales concernant le frottement intérieur et le comportement rhéologique des solides vitreux vers la transition vitreuse, sont rappelées ; une dist inction est faite entre les données maintenant bien établies et celles plus récentes. L'interprétation de l'ensemble exige l'intervention de concepts nouveaux : celui de "défaut" où serait localisé le cisaillement et celui de mouvement atomique (moléculaire) corrélés. De nouvelles expressions sont établies et la loi de Kohlrauschexp$[-(t/T)^b]$ se trouve introduite à partir des concepts physiques précédents ; ces expressions sont confrontées aux données expérimentales.

Abstract - The main experimental features about internal friction and rheological behavior of glasses near the glass transition temperature Tg are recalled. Some are now well established, others have been obtained recently. In order to interprete all these, new ideas have to be developped : hence, the concepts of "defect" on which local shear is obtained and of correlated atomic (molecular) movements, are applied to non-crystalline solids. New Eq. including the Kohlrausch law exp $[-(t/T)^b]$ emerge naturally from such physical basis and are discussed by reference to experimental data.

I - INTRODUCTION

There have been numerous investigations on the homogeneous flow and anelastic-plastic deformation of vitreous solids. Most attention has been given to rheological behaviour of glasses near glass transition temperature Tg and several review articles have been published in this field /1,2,3/.
The main interest of internal friction studies done with glasses is connected to the informations thus obtained about atomic (molecular) mobility in this state of the matter, as internal friction is a very sensitive and effective tool to detect internal atomic rearrangements. Atomic movements are usually associated with lattice defects. Since vitreous solids could be considered as extremely defective solids it is expected that they may exhibit a considerable amount of internal friction especially when the temperature is increased approaching the glass transition temperature Tg. Actually it is generally admitted that long range atomic (molecular) movements are only possible at temperature equal or higher than Tg although more local movements could exist at lower temperature /4/.
In the work reported in this paper, attempts were made to bring some new contribution in the analysis of internal friction of glasses near Tg. In this aim the main experimental and theoretical features will be firstly recalled. In a second part, new results or results recently obtained will be presented in order to focus our attention on the peculiar points which must be taken into account to improve the theories previously proposed. A new approach about the interpretation of atomic (molecular) mobility in glasses will be discussed in the third part which will be followed by the interpretation of anelasticity and viscous glow of glasses in the glass temperature region. As a conclusion, the vew thus presented will be tested with the available literature data.